ASD-TR-82-5012

HANDBOOK OF MILITARY AIRCRAFT DESIGN
NORMAL LOAD FACTOR EXCEEDANCE DATA

RAY J. VELDMAN
CYRIL PECKHAM
LOADS AND DYNAMICS BRANCH
STRUCTURES DIVISION

ASD/ENFSL
WPAFB OH 45433

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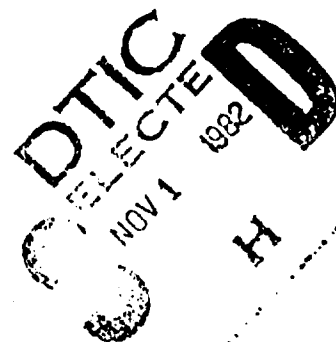Interim Report Period September 1965 - March 1982

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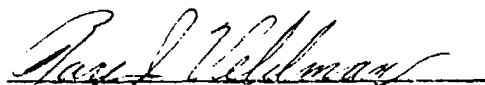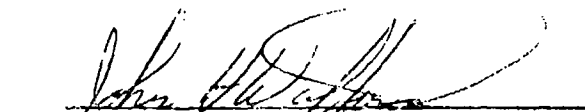WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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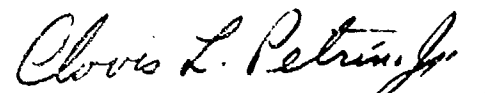
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RAY J. VELDMAN
Project Engineer

JOHN H. WAFFORD, Chief
Loads & Dynamics Branch

FOR THE COMMANDER

CLOVIS L. PETRIN, JR., Chief
Structures Division

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*
The information presented in this handbook is derived from airborne data recorded using oscillograph and magnetic tape systems collecting Loads Environment Spectra Survey Data on a multitude of USAF aircraft.

The data is broken down into three main categories: Cargo Class, Fighter/ Attack Class, and Trainer Class. Special information included in the handbook are Ground Data from the C-141 and Aerial Refueling from the C-5. The

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20.   (continued)

data is broken down by aircraft, mission, and mission phase.   Plots are
provided and show comparisons of different aircraft models.   The tables
presented express NZ (normal load factor)   in exceedances per 1000 flight
hours and ground data in exceedances per 1000 flights.

FOREWORD

This report was prepared by the Directorate of Flight Systems Engineering, Deputy for Engineering, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio, Messrs. Cyril G. Peckham and Ray J. Veldman (ASD/ENFSL).

The authors gratefully acknowledge the assistance of Mr. Robert Mach, Aerospace Engineer (ASD/ENFSL); Mr. David J. Nowery and Mr. Lawrence C. Sloser, student engineering trainees from the University of Cincinnati; and Mr. Faustino Zapata, a student engineering trainee from the Illinois Institute of Technology.

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SECTION 1

INTRODUCTION

The US Air Force has been using the normal load factor exceedance data provided in Mil-A-8866 as design criteria for new aircraft since 1960. Two updates to this specification have occurred, in 1971 and 1975, but the load factor tables presented are still based upon a minimal amount of actual in-service data. In recent years the Force Management Group of ASD/ENFSL has provided normal load factor spectra for specific mission phases to supplement Mil-A-8866 for use in new aircraft Requests For Proposals.

This handbook represents a compilation of thousands of hours of actual operational usage recorded data from many aircraft flying most missions and mission phases in both combat and noncombat environments. It is intended to supplement Tables I-VIII of Mil-A-008866B (USAF) as design spectra for new aircraft and selected sections will be referenced in future design requirements documents.

Since new data is continuously recorded on current aircraft, this handbook will be updated as necessary to reflect the newly acquired service information.

SECTION 2

DISCUSSION

All tables appearing in the handbook use the same load factor (N_Z) interval definition. For example, if the load factor exceedances listed are - - - 0.6, 0.4, 0.2   -0.2, -0.4, -0.6 - - -, the data appearing under 0.2 and -0.2 include the interval from 0.2 to 0.4 and -0.2 to -0.4 respectively, but does not include the value of 0.4 or -0.4. It should be noted that all tables and plots list the reference and the amount of data represented. This is an indication to the user of the expected data stability. For example, the F-16 data sample is quite small since this is a relatively new recording effort. Although use of this data as criteria for a new aircraft would be questionable, additional data being recorded is suggesting early data stability for most missions.

Many of the plots appearing in this report have data points from similar missions presented with a curve faired between the points. The curve represents our recommended representation of the average mission. It should also be noted that all points that appear on the plots represent actual recorded data points. Any extrapolation of these points could lead to serious inaccuracies. The user should coordinate any extrapolation of the data points or any use of small sample data with this office.

SECTION 3

DATA

This section contains three classes of aircraft data which are Cargo, Fighter/Attack and Trainer. All the data is presented in the form of tables and illustrations.

TABLE 1

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

WORLDWIDE MISSION DATA

CARGO CLASS

ΔNZ	TRAINING	COMBAT TRAINING	LOGISTICS < 5 HRS	LOGISTICS HRS
2.0				
1.8				
1.6				
1.4	1.6	1.5		
1.2	5.2	3.0		
1.0	18.8	9.5	5.7	.4
0.9	33	26	10.4	1.2
0.8	69	78	19.3	3.1
0.7	145	233	35	7.0
0.6	366	636	84	17.4
0.5	939	1950	199	43
0.4	2465	6249	508	116
0.3	7859	19487	1609	364
0.2	24662	52478	5592	1483
-0.2	36811	60941	11007	4034
-0.3	7499	16795	1544	463
-0.4	1506	4203	258	85
-0.5	710	1720	110	43
-0.6	323	955	51	21.3
-0.7	72	160	10.9	5.9
-0.8	17.3	32	3.3	1.7
-0.9				
-1.0				
HOURS:	9859	838	10113	8825

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TABLE 1

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

WORLDWIDE MISSION DATA

CARGO CLASS

ΔNZ	RESCUE	SHUTTLE	AIR DROP			
2.0						
1.8						
1.6						
1.4			1.2			
1.2		1.0	6.6			
1.0		4.4	35			
0.9		8.8	50			
0.8	3.9	20.1	117			
0.7	9.7	41	215			
0.6	30	97	497			
0.5	85	238	1111			
0.4	290	817	2940			
0.3	1233	2847	8295			
0.2	5435	10496	25456			
-0.2	9706	19093	39220			
-0.3	1362	2210	8221			
-0.4	186	319	1717			
-0.5	89	140	820			
-0.6	39	59	348			
-0.7	10.0	12.4	74			
-0.8	2.8	2.9	17.7			
-0.9						
-1.0						
HOURS:	1816	3437	1697			

HOURS REFERS TO AMOUNT OF RECORDED DATA

REFERENCE: C-130, (SEG-TR-65-34), (70-WRNE-199), (ASD-TR-64-78), (WRAMA-72-MME-011)

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TABLE 2

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

CARGO CLASS   WORLDWIDE LOGISTICS MISSION PHASE DATA

ΔNZ	LOGISTICS <5 HRS ASCENT	LOGISTICS <5 HRS CRUISE	LOGISTICS <5 HRS DESCENT	LOGISTICS >5 HRS ASCENT	LOGISTICS >5 HRS CRUISE	LOGISTICS >5 HRS DESCENT
2.0						
1.8						
1.6						
1.4						
1.2						
1.0			14.9			
0.9			30			
0.8	5.0	1.0	69			
0.7	11.4	3.5	140			
0.6	35	11.5	366		2.0	
0.5	145	37	770		5.0	
0.4	690	122	1986	85	19.6	686
0.3	3054	391	5939	831	51	2744
0.2	10869	1236	19118	3878	275	9768
-0.2	24404	3352	33997	11975	1436	24404
-0.3	4126	450	5899	1215	100	4116
-0.4	740	95	1030	106	13.7	555
-0.5	340	37	470	47	4.6	255
-0.6	154	17.7	193	21.3	2.0	131
-0.7	42	6.4	41			
-0.8	9.9	3.1	9.9			
-0.9						
-1.0						
HOURS:	201	958	202	47	510	31

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TABLE 3

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

CARGO CLASS   SOUTHEAST ASIA OPERATIONS MISSION DATA

ΔNZ	SHUTTLE	LOGISTICS <5 HRS
2.0		
1.8	.2	
1.6	.25	
1.4	.35	
1.2	.5	
1.0	3.5	2.4
0.9	8.6	5.5
0.8	20.9	13.4
0.7	48	32
0.6	131	85
0.5	310	260
0.4	992	725
0.3	3171	2348
0.2	10749	7774
-0.2	22578	14746
-0.3	2721	2266
-0.4	386	360
-0.5	139	145
-0.6	61	44
-0.7	12.4	8.4
-0.8	3.3	1.2
-0.9		
-1.0		
HOURS:	5738	2460

REFERENCE: C-130B, E, (TI-243-69-24)

HOURS REFERS TO AMOUNT OF RECORDED DATA

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TABLE 3

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

CARGO CLASS   SOUTHEAST ASIA MISSION DATA

ΔNZ	LOGISTICS <5 HRS & SEA	SHUTTLE
2.0		
1.8		
1.6		
1.4		
1.2		
1.0	5.1	.3
0.9	9.3	3.6
0.8	18.1	20.6
0.7	35	48
0.6	84	119
0.5	209	310
0.4	550	927
0.3	1754	3049
0.2	6019	10654
-0.2	11738	21272
-0.3	1686	2530
-0.4	278	361
-0.5	138	140
-0.6	50	60
-0.7	12.0	12.5
-0.8	2.9	3.2
-0.9		
-1.0		
HOURS:	12579	9175

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TABLE 3

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

SOUTHEAST ASIA OPERATIONS MISSION PHASE DATA

CARGO CLASS

ΔNZ	SHUTTLE ASCENT	SHUTTLE CRUISE	SHUTTLE DESCENT	LOGISTICS <5 HRS ASCENT	LOGISTICS <5 HRS CRUISE	LOGISTICS <5 HRS DESCENT
2.0						
1.8						
1.6						
1.4						
1.2						
1.0	2.5		8.2			
0.9	4.6		22.5			
0.8	9.1	1.1	60	7.0	1.3	18.9
0.7	31	8.5	144	11.5	3.4	51
0.6	111	23	357	28	11.1	175
0.5	285	58	920	86	30	405
0.4	935	157	2699	327	99	1222
0.3	3516	519	8228	1356	314	4405
0.2	13473	2182	25900	6285	1155	16305
-0.2	37455	7880	40545	19324	2797	37518
-0.3	4715	742	5030	2401	355	4784
-0.4	625	130	661	296	61	658
-0.5	220	57	250	77	25	230
-0.6	101	25	93	21.1	10.5	81
-0.7	26	6.5	13.0		1.6	23
-0.8	5.8	2.1	2.2		.6	9.5
-0.9						
-1.0						
HOURS:	1214	2820	1336	284	1528	211

HOURS REFERS TO AMOUNT OF RECORDED DATA

REFERENCE: C-130B, E, (TI-243-69-24)

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TABLE 4

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

MISSION PHASE DATA

ΔNZ	CARGO CLASS					
	LOGISTICS ASCENT	LOGISTICS CRUISE	LOGISTICS DESCENT	SHUTTLE ASCENT	SHUTTLE CRUISE	SHUTTLE DESCENT
2.0						
1.8						
1.6						
1.4						
1.2						
1.0			7.3	2.3		8.5
0.9			17.3	3.6		20.5
0.8	6.2	1.2	44	9.4	1.0	60
0.7	12.5	3.6	102	31	5.2	137
0.6	31	11.3	269	108	22.4	353
0.5	94	35	560	280	52	900
0.4	478	108	1596	926	159	2681
0.3	2060	344	5155	3463	519	8153
0.2	8187	1186	17680	13314	2170	25601
-0.2	21432	3010	35797	37164	7865	40216
-0.3	3117	391	5329	4702	742	4974
-0.4	480	74	840	630	127	665
-0.5	190	30	350	285	56	280
-0.6	76	13.3	136	109	25	92
-0.7	13.5	3.6	33	25	8.1	13.5
-0.8	4.1	1.6	9.7	6.3	3.1	2.1
-0.9						
-1.0						
HOURS:	485	2486	413	1278	2945	1408

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TABLE 5

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

CARGO CLASS   TRAINING MISSION PHASE DATA

ΔNZ	ASCENT	CRUISE	DESCENT	BEFORE DROP	AIR DROP	AFTER DROP
2.0						
1.8						
1.6						
1.4						
1.2						
1.0	8.0	6.6	14.0	9.8		12.4
0.9	16.2	13.0	37	20.5		49
0.8	40	30	98	47	27	156
0.7	71	65	245	145	59	320
0.6	183	163	679	565	157	1027
0.5	375	370	1550	1200	560	2080
0.4	1115	921	3871	4627	1951	6540
0.3	3883	2521	10829	13269	7488	16024
0.2	14377	7294	29685	33536	27753	39241
-0.2	34300	11200	46955	37556	39856	39813
-0.3	5814	2443	10675	14887	8625	13416
-0.4	1041	642	2132	4531	1689	4163
-0.5	400	340	770	2300	810	1900
-0.6	170	179	367	1338	368	1008
-0.7	35	45	49	380	75	295
-0.8	8.0	10.6	7.0	86	13.5	75
-0.9						
-1.0						
HOURS:	376	1513	286	409	222	161

HOURS REFERS TO AMOUNT OF RECORDED DATA

REFERENCE: C-130A/B, E, (WRAMA-72-MME-011), (70-WRNE-199), (SEG-TR-65-34), (ASD-TR-64-78)

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TABLE 6

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

CARGO CLASS   RESCUE MISSION PHASE DATA

ΔNZ	ASCENT	CRUISE	DESCENT
2.0			
1.8			
1.6			
1.4			
1.2			
1.0			
0.9			
0.8		2.8	18.4
0.7		5.2	41
0.6	17.1	13.3	129
0.5	69	38	270
0.4	291	119	783
0.3	1285	503	3370
0.2	5467	2482	14908
-0.2	19512	4106	33103
-0.3	2665	495	4587
-0.4	411	73	580
-0.5	165	37	265
-0.6	60	13.3	138
-0.7		3.0	26
-0.8		1.0	9.2
-0.9			
-1.0			
HOURS:	117	1054	109

HOURS REFERS TO AMOUNT OF RECORDED DATA

REFERENCE: C-130P, H, (70-WRNE-199)
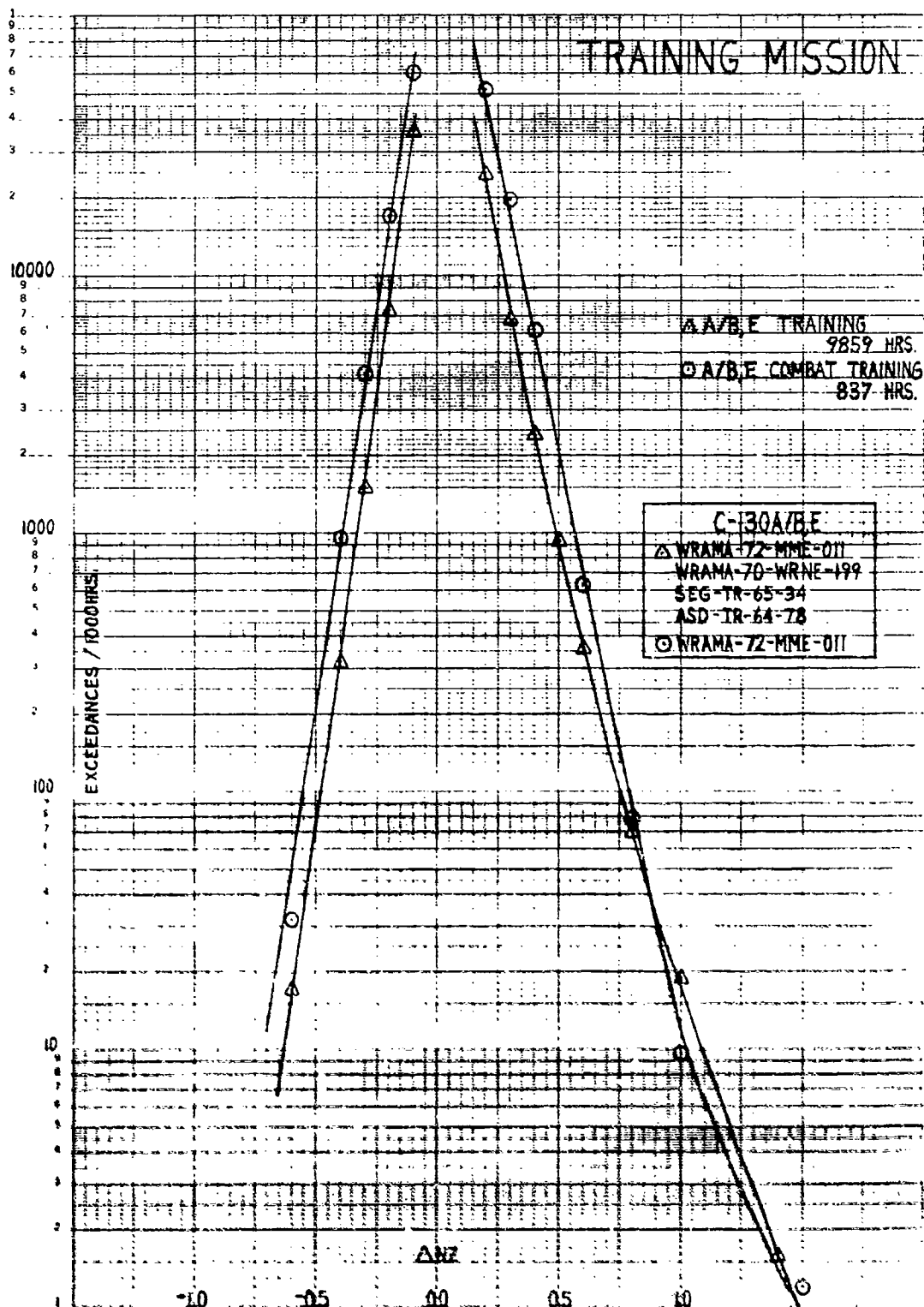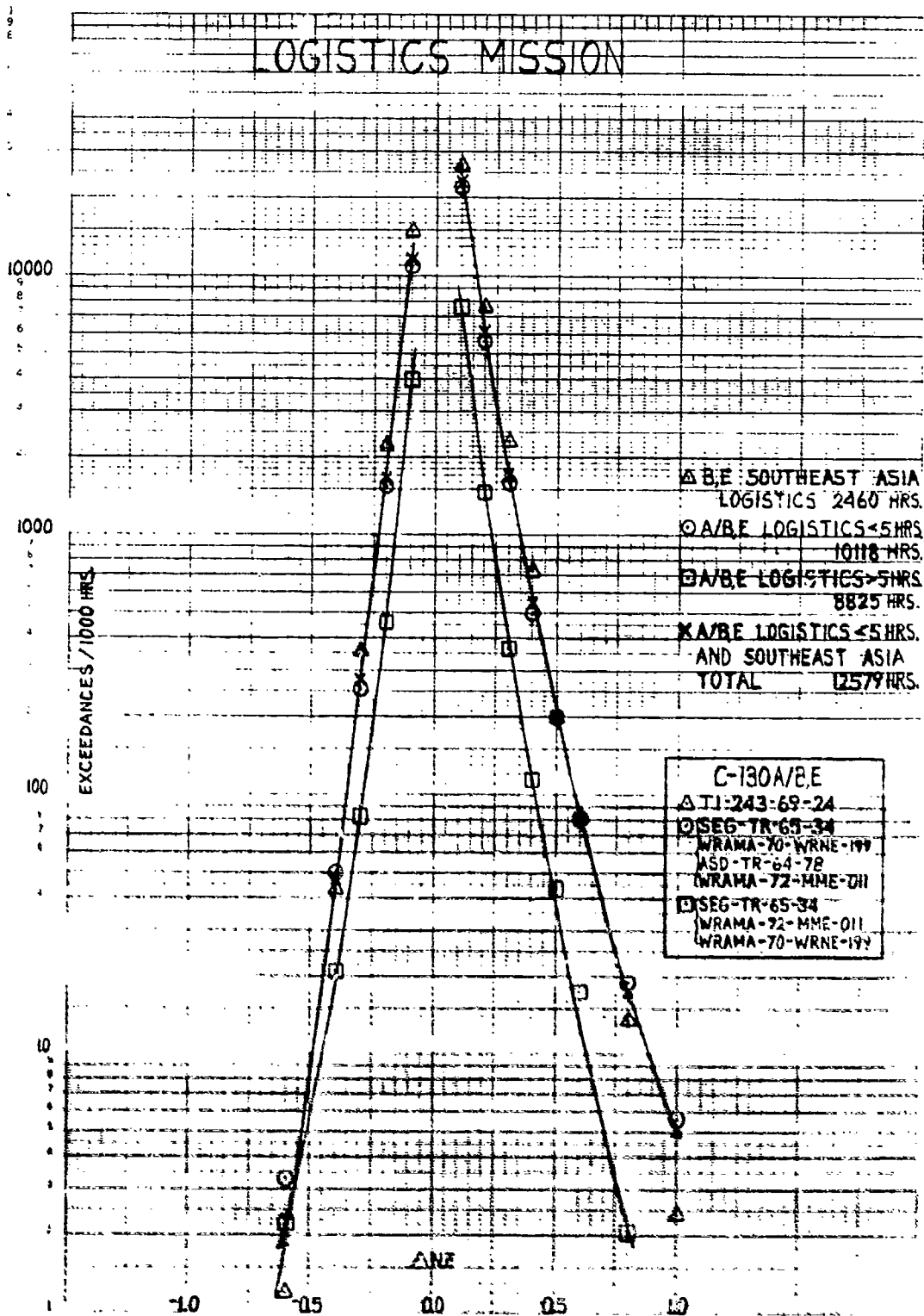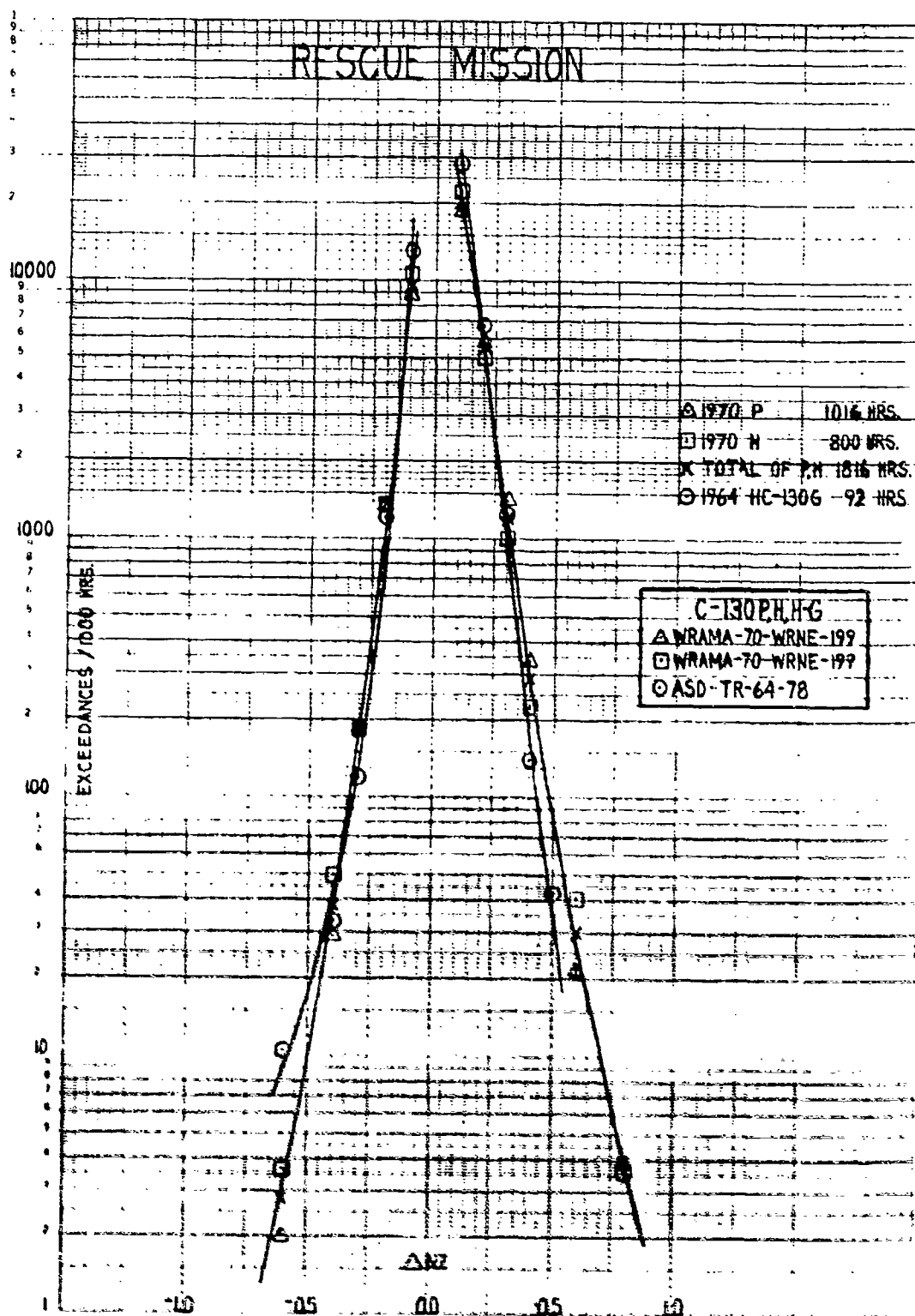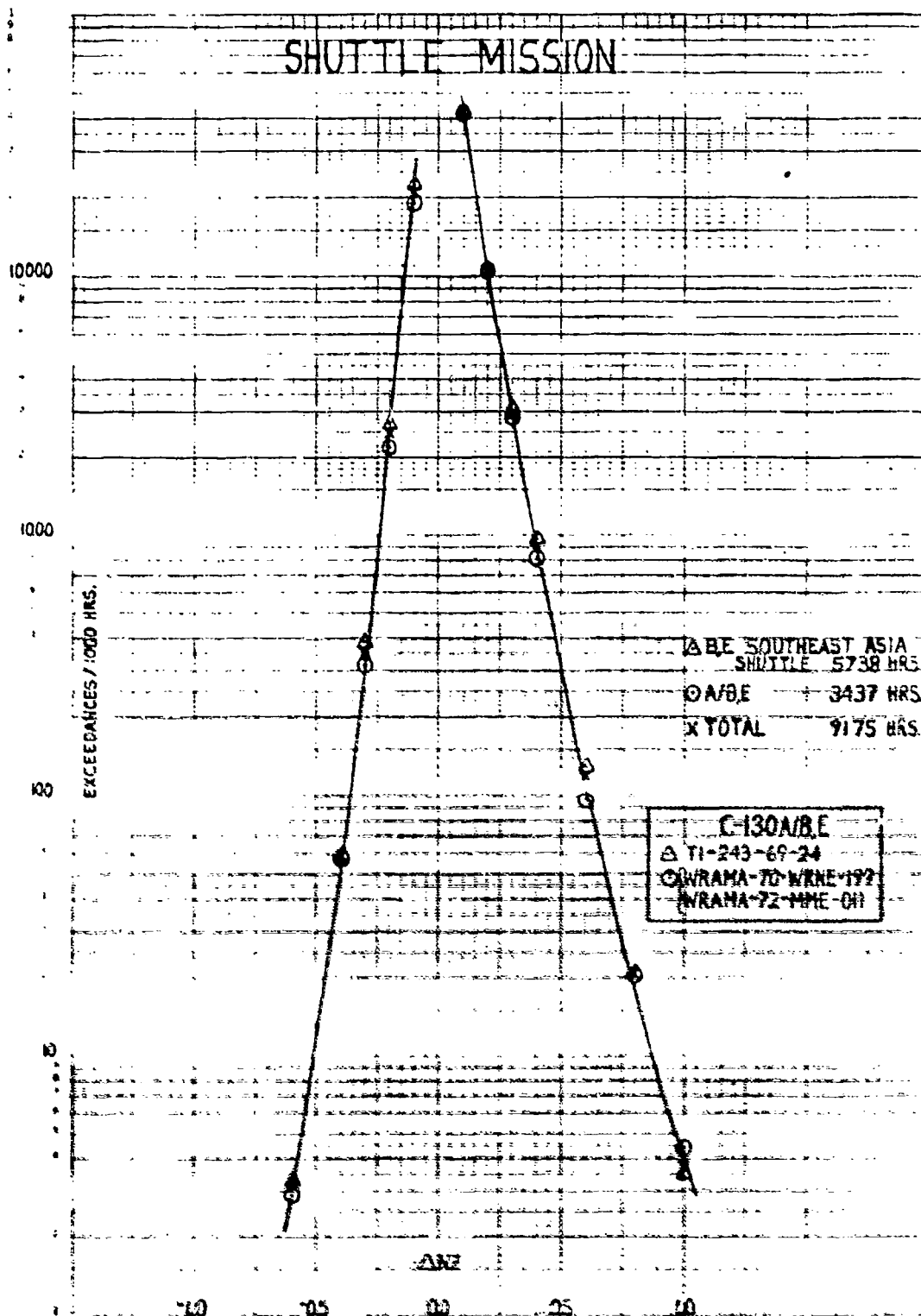
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FIGURE 1

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FIGURE 2

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FIGURE 3

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FIGURE 4

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FIGURE 5

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FIGURE 6

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FIGURE 7

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FIGURE 8

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FIGURE 9

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FIGURE 10

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FIGURE 11

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FIGURE 12

23

FIGURE 13

24

FIGURE 14

25

FIGURE 15

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CRUISE

FROM RESCUE MISSION

△ 1970 P   566 HRS.
⊙ 1970 H   488 HRS.
X TOTAL   1054 HRS.

C-130 P, H
△ WRAMA-70-WRNE-199
⊡ WRAMA-70-WRNE-199

EXCEEDANCES / 1000 HRS

ΔNZ

FIGURE 16

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FIGURE 17

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FIGURE 18

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FIGURE 19

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FIGURE 20

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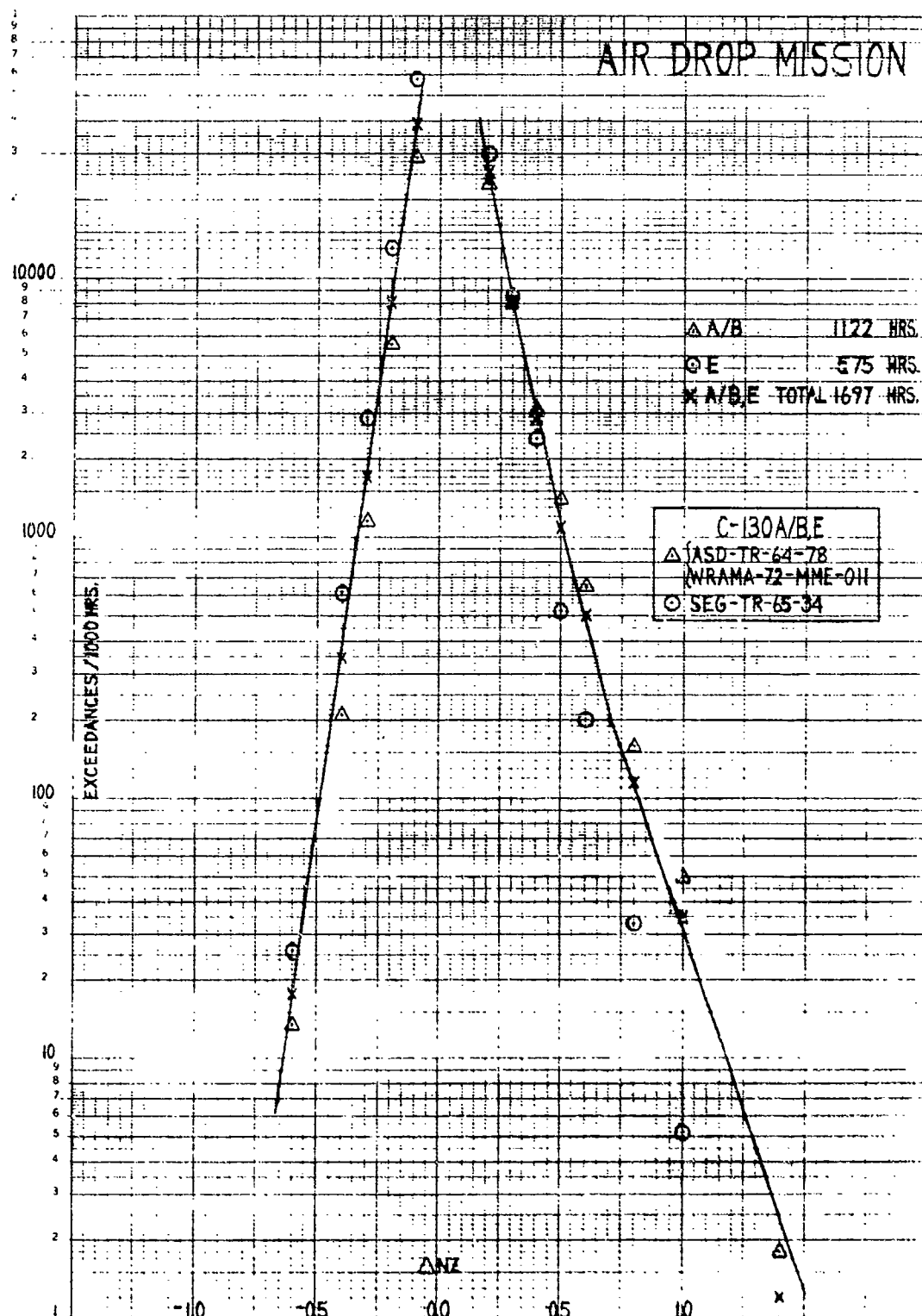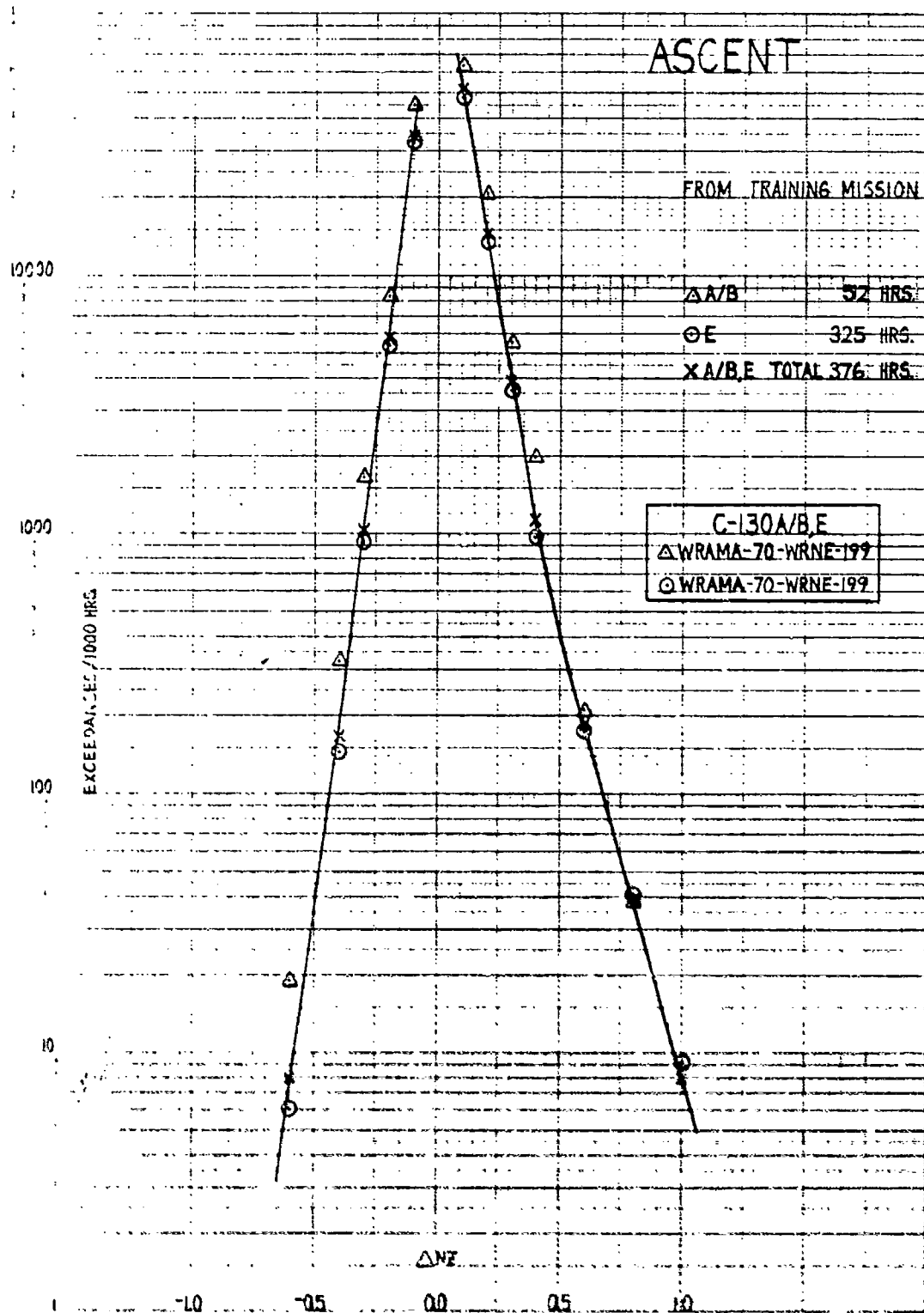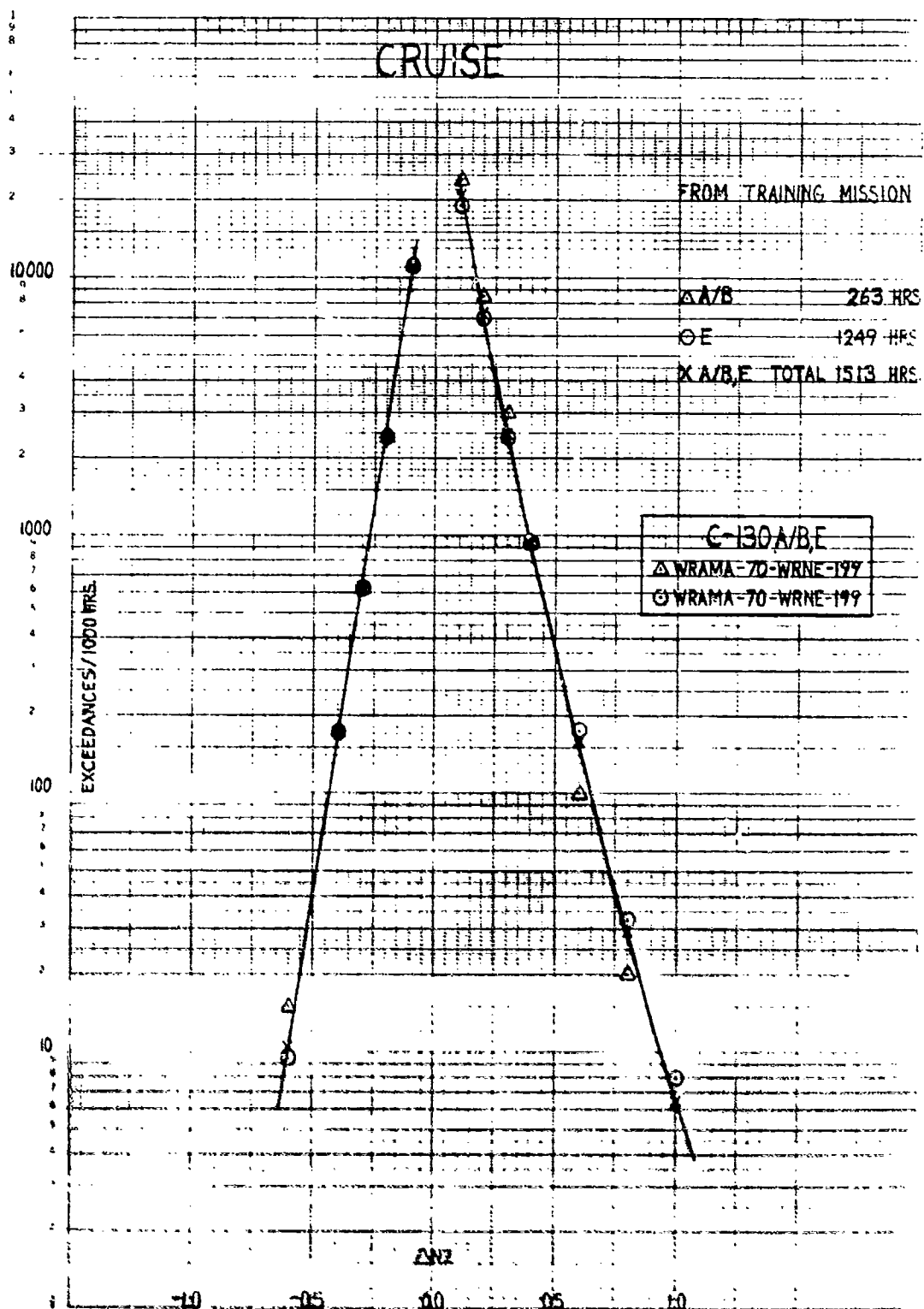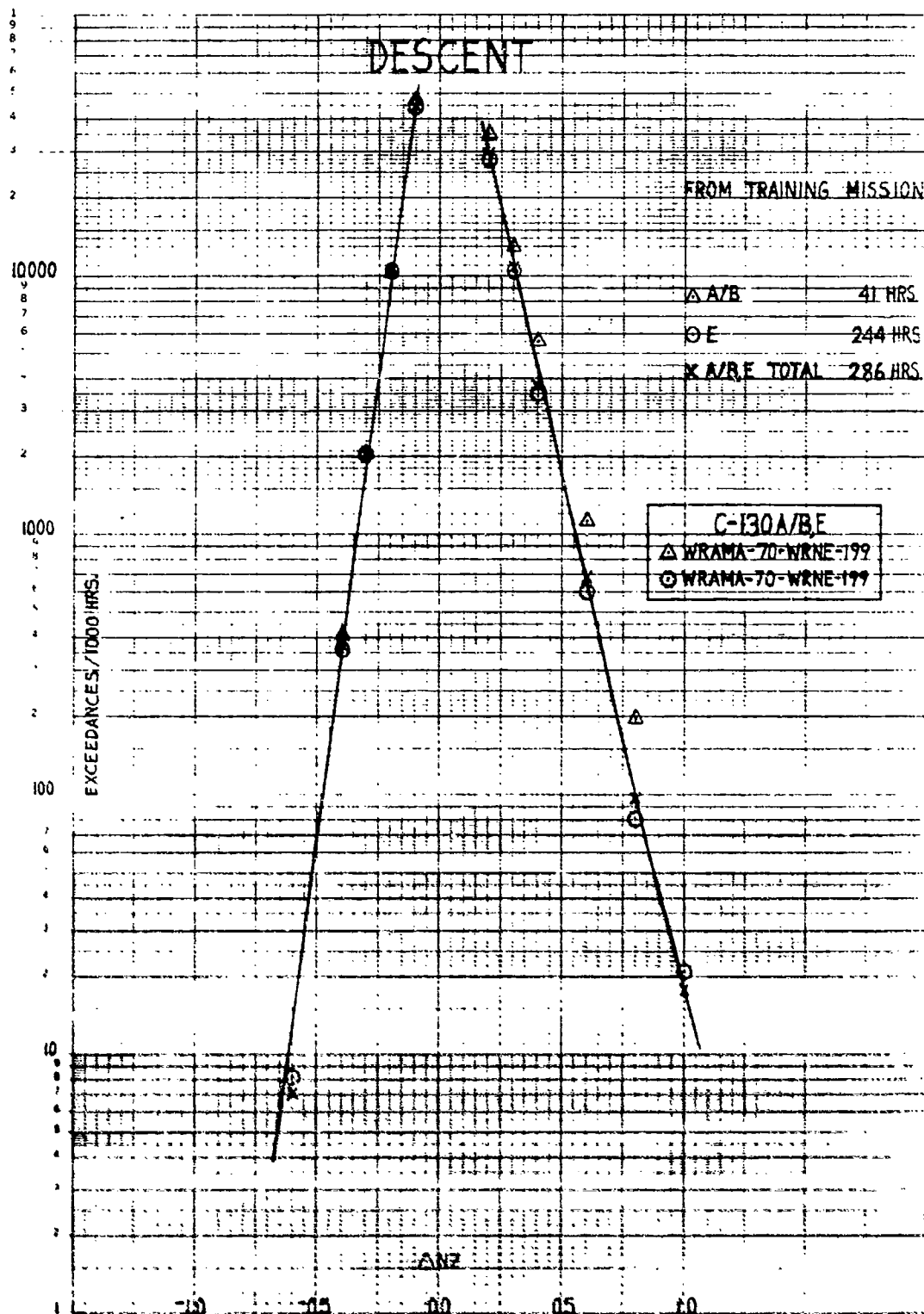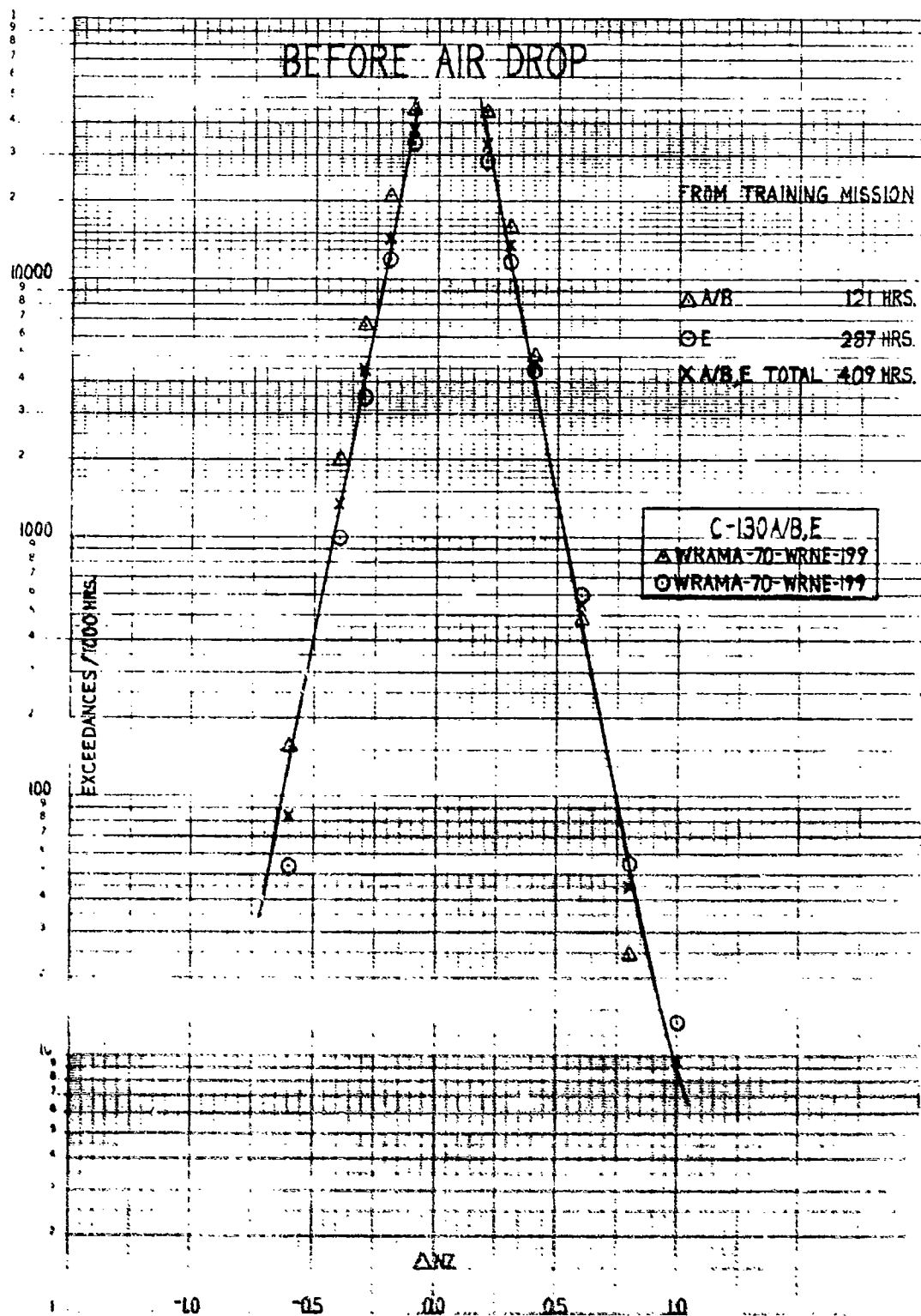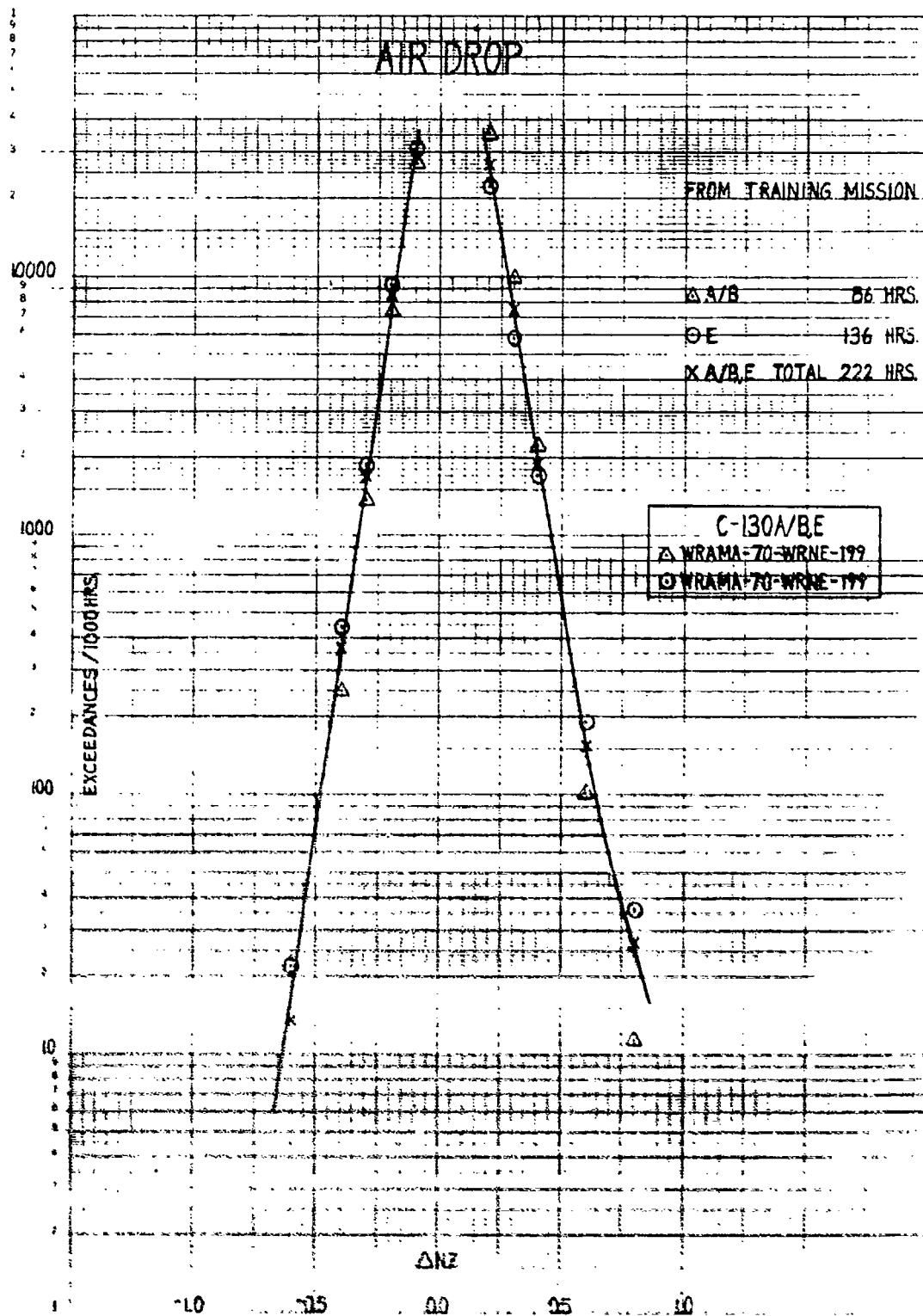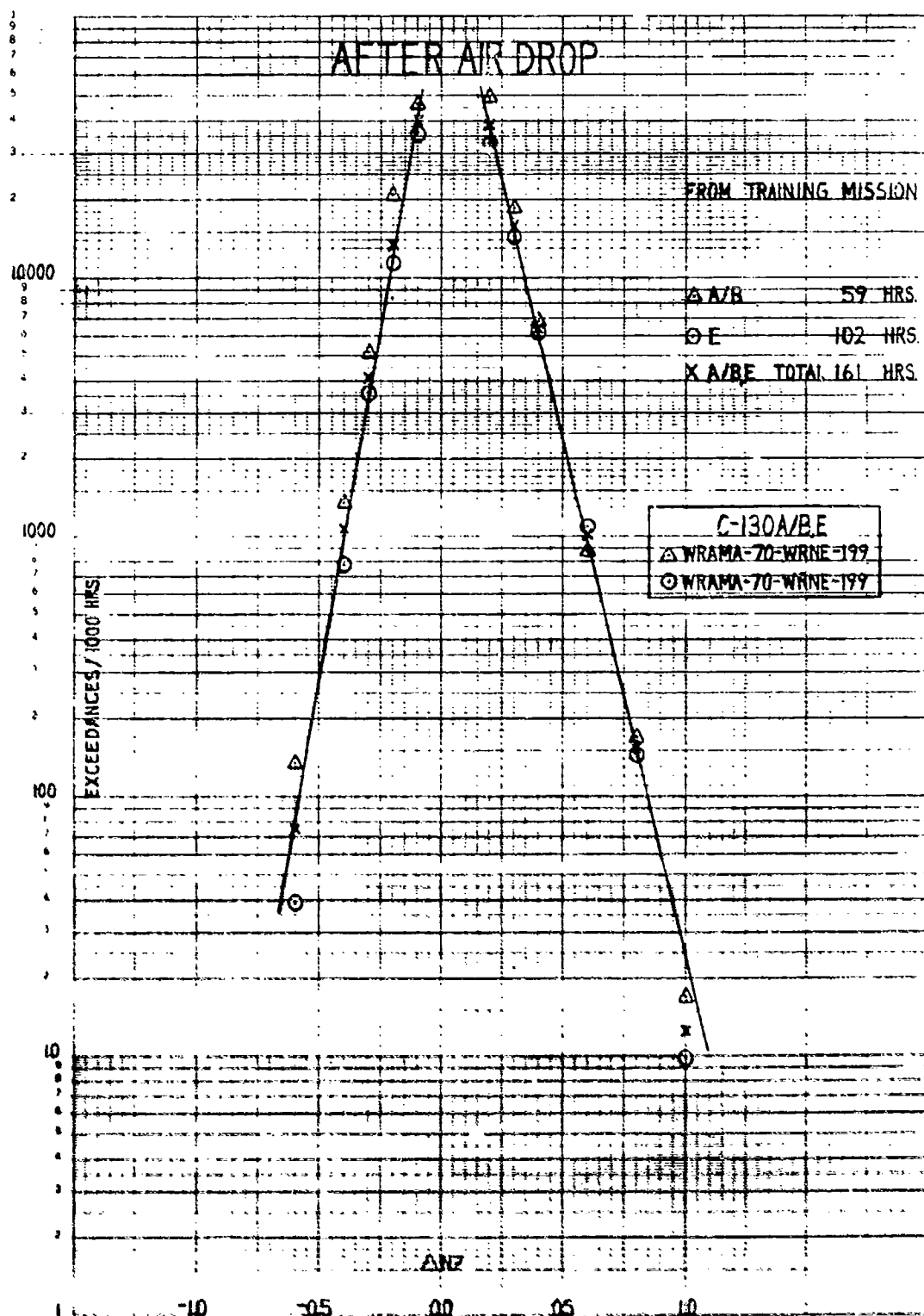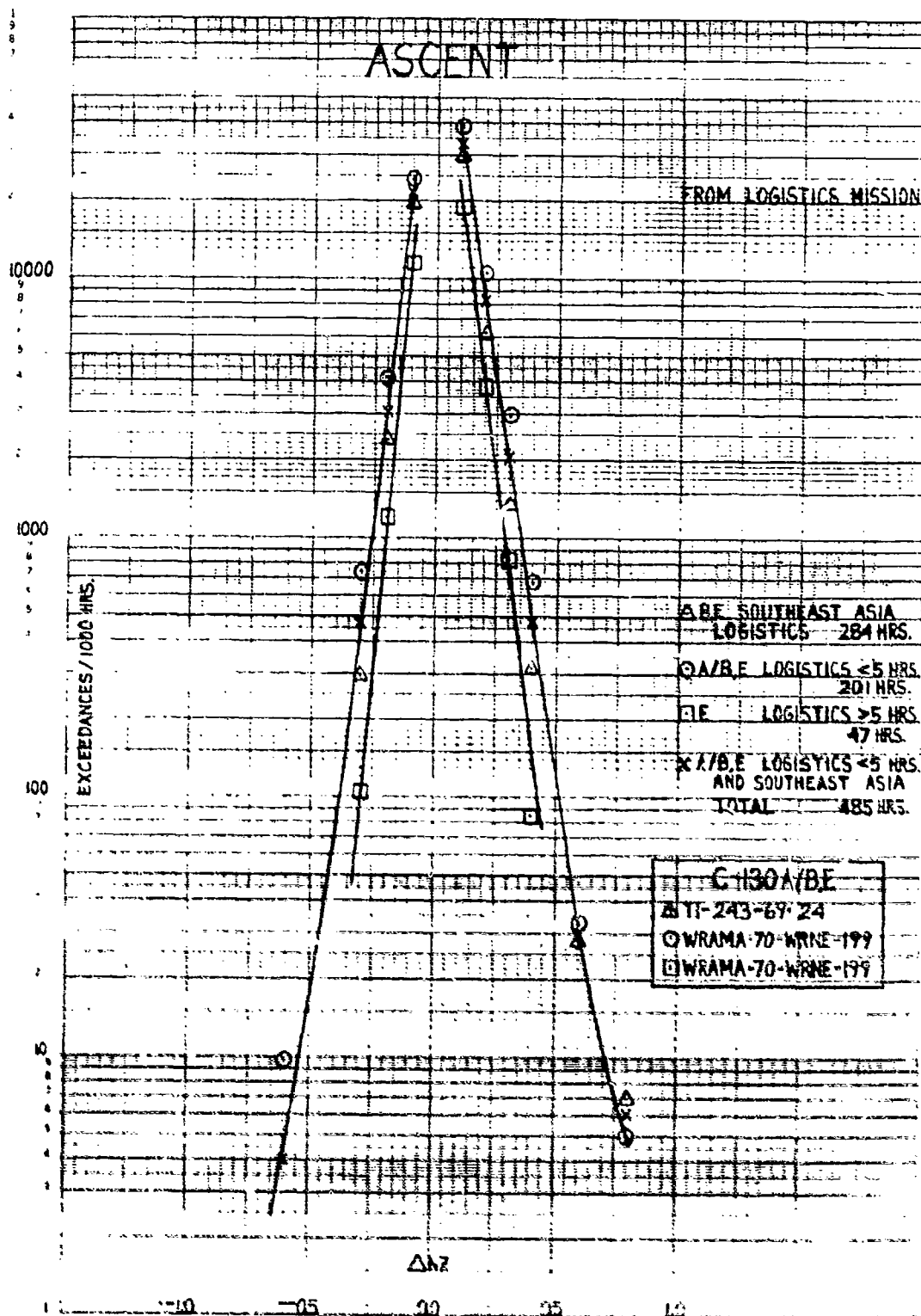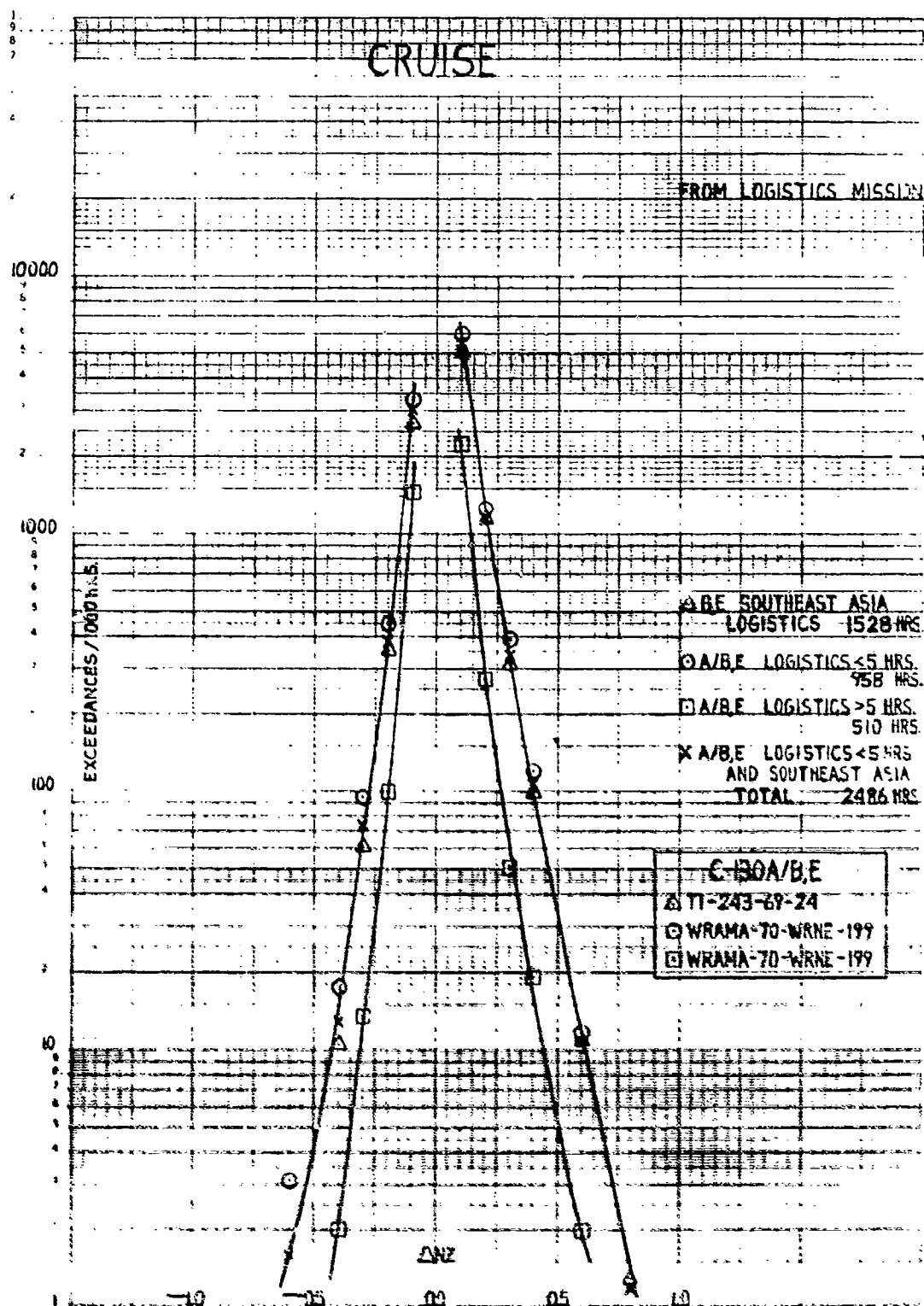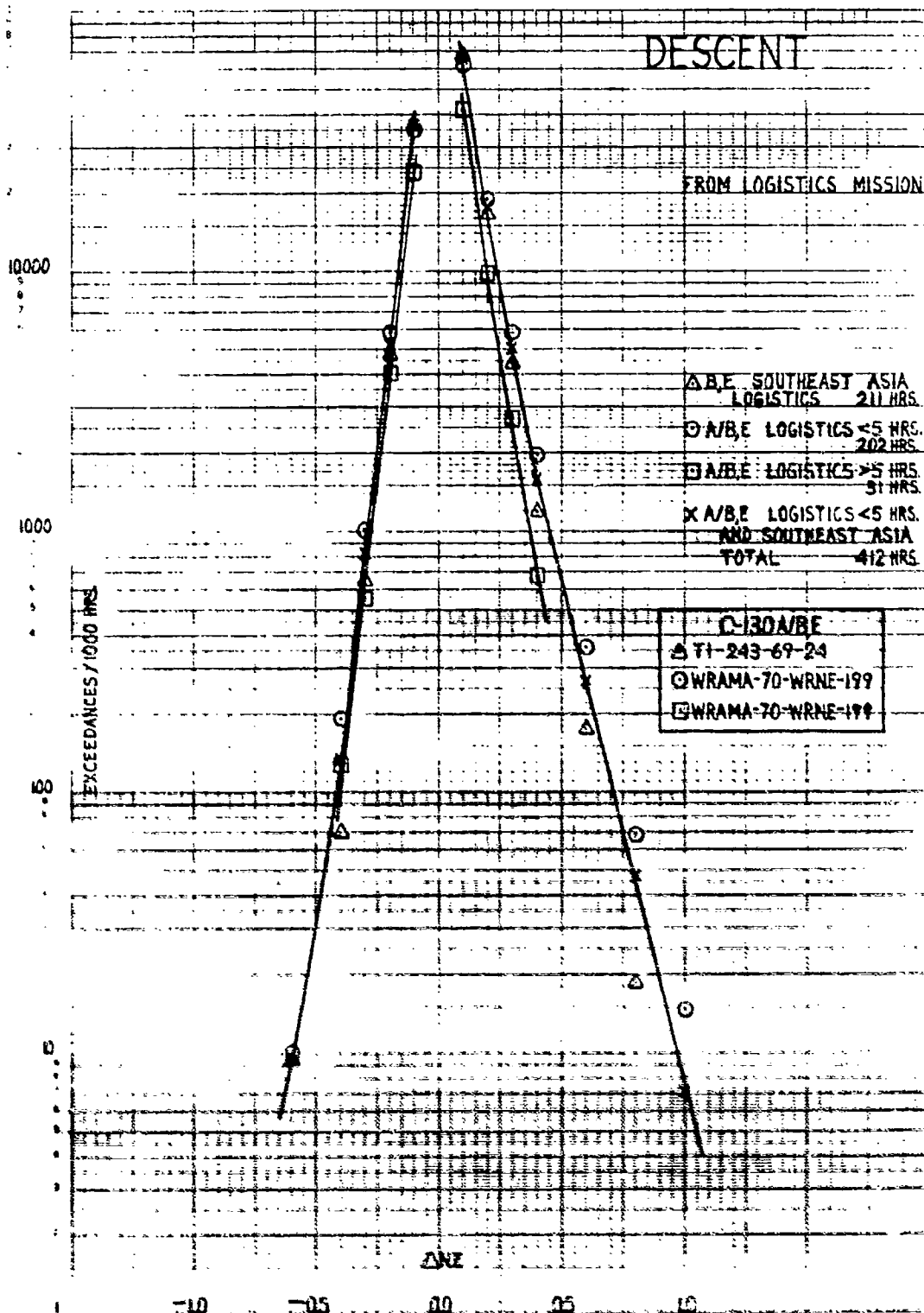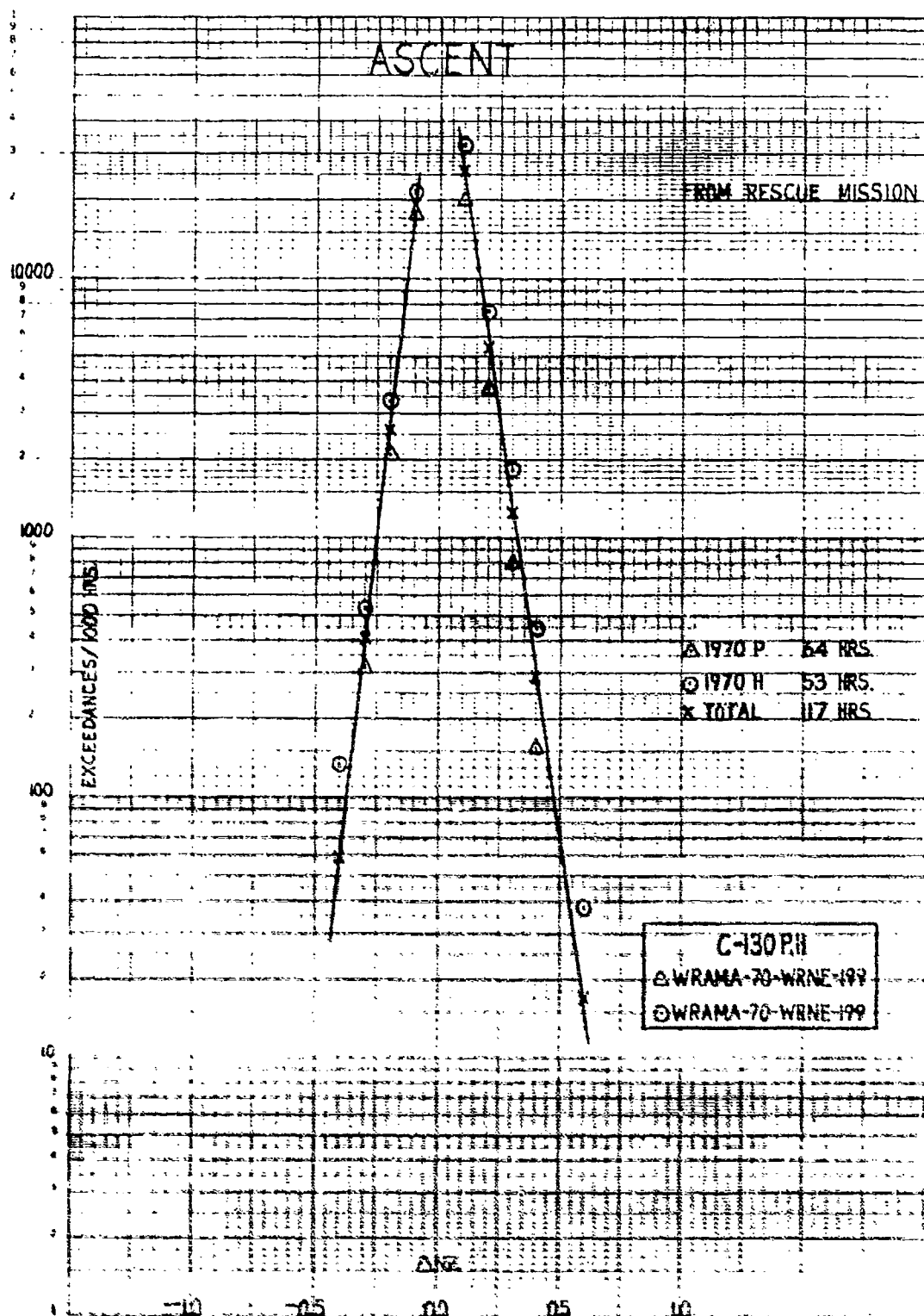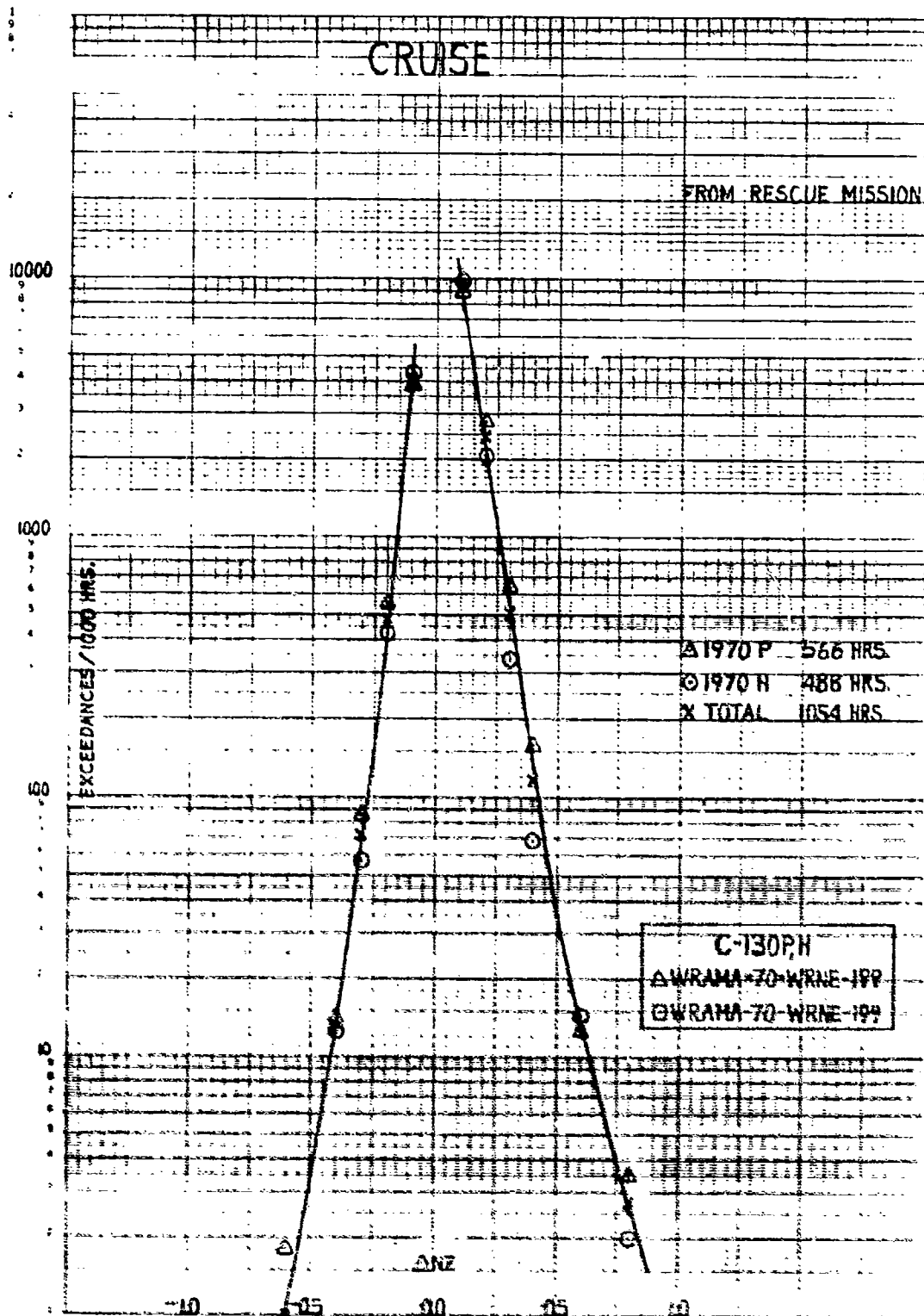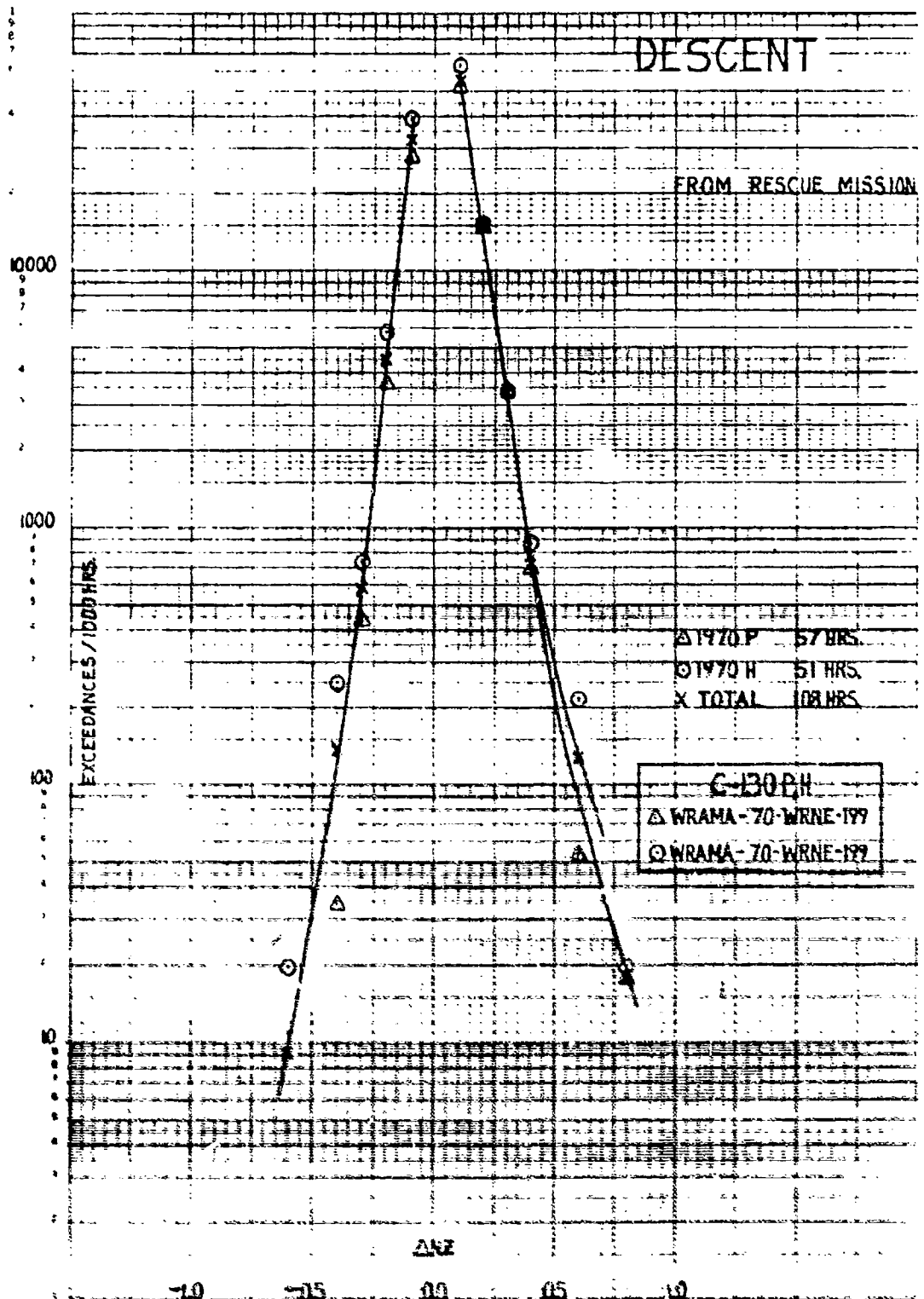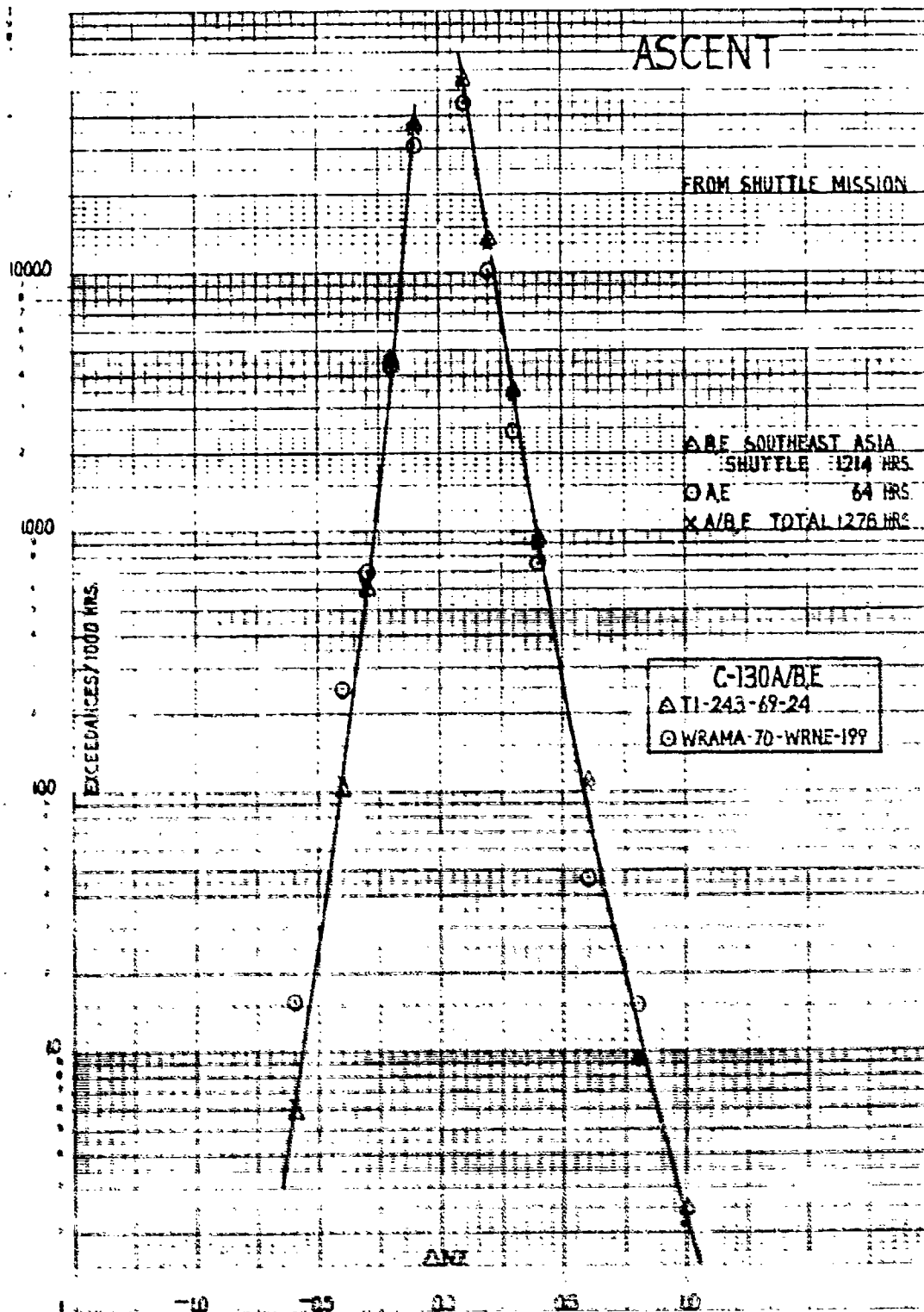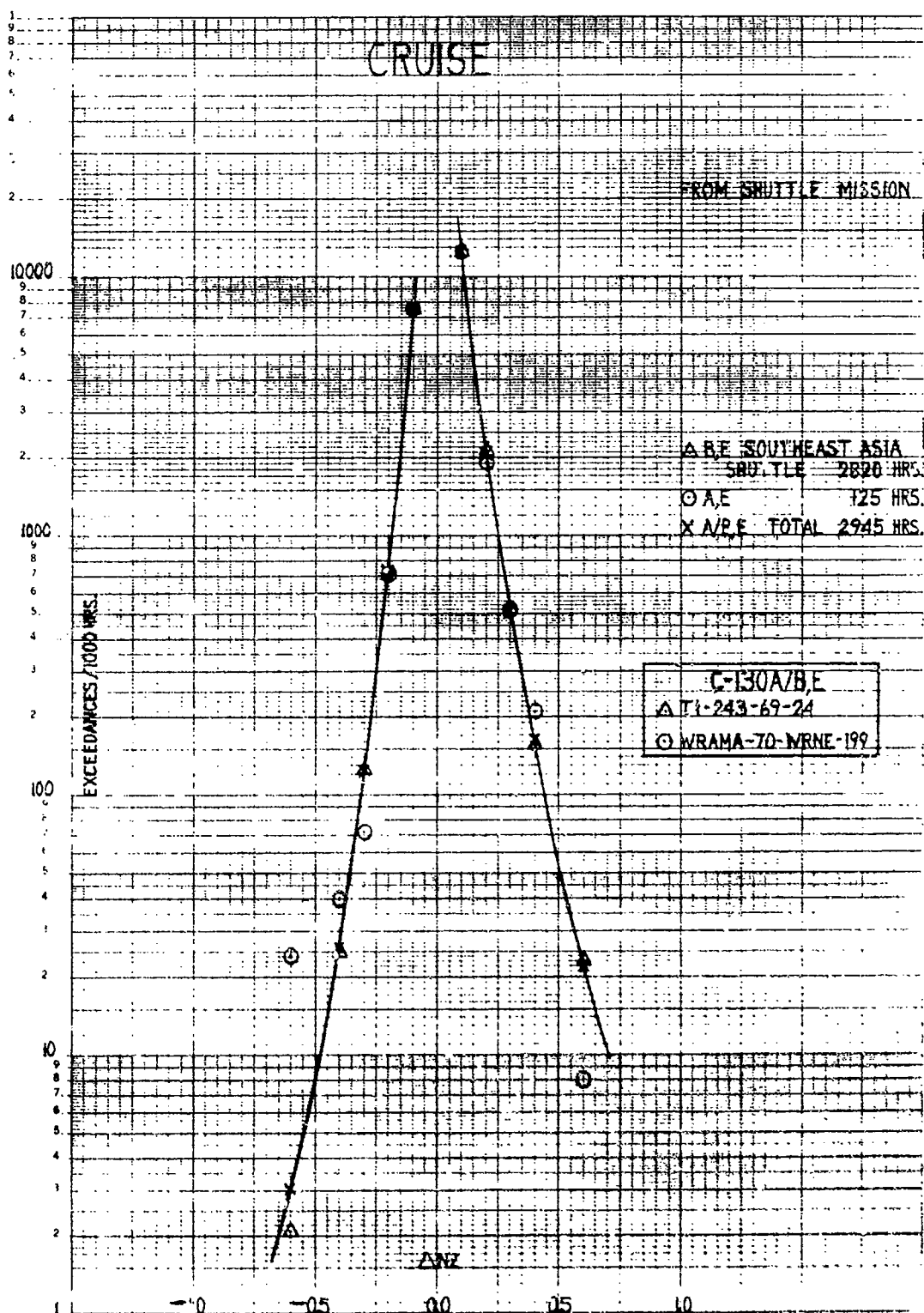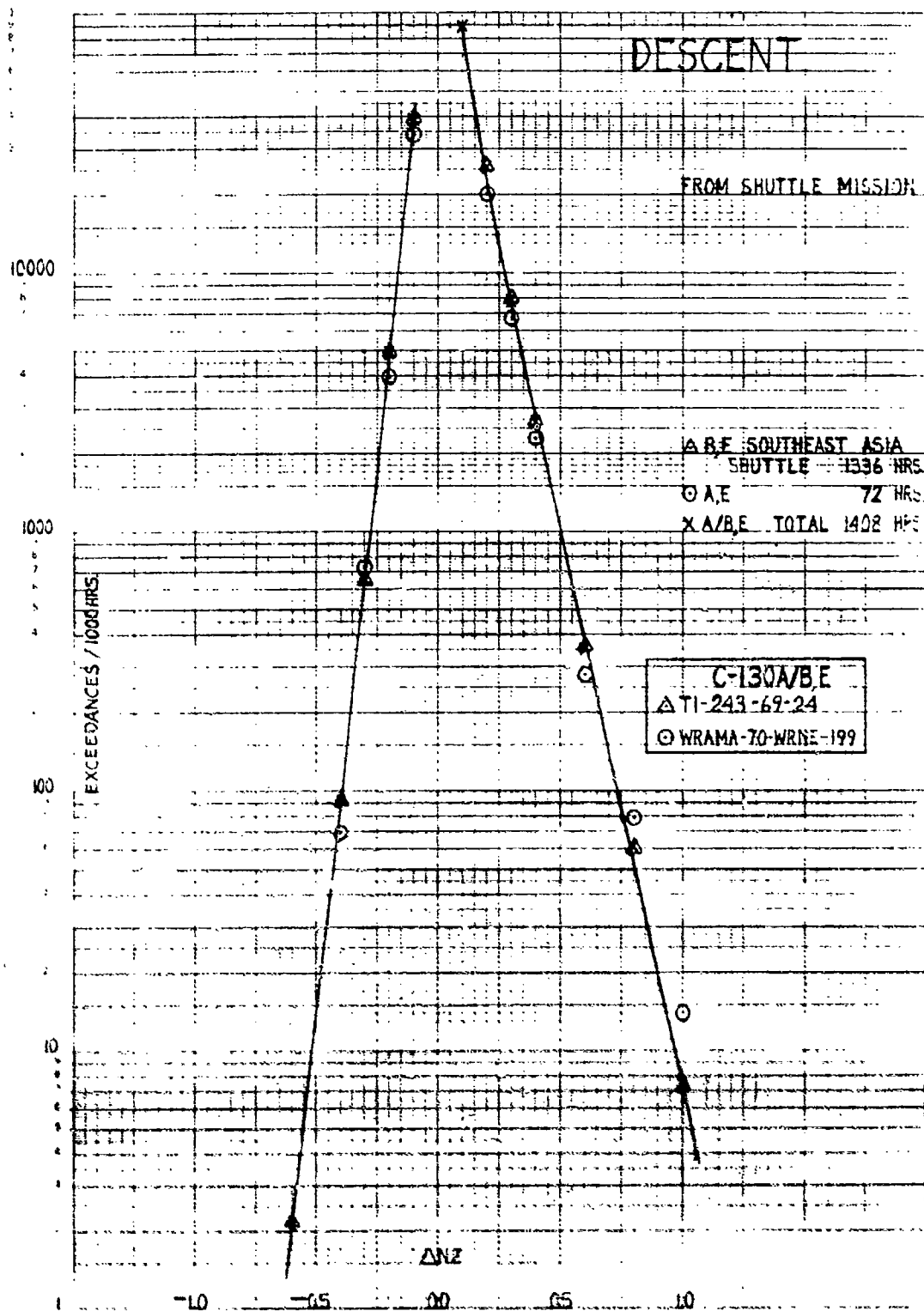
TABLE 7

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

MISSION DATA

CARGO CLASS

ΔNZ	TRAINING	LOGISTICS < 4 HRS.	LOGISTICS 4-10 HRS.	LOGISTICS > 10 HRS.
1.6				
1.4	1.5			
1.2	5.4			
1.0	24			
0.9	50			
0.8	93	1.2	.6	
0.7	255	2.8	1.5	
0.6	579	11.6	5.2	2.4
0.5	1520	45	17.0	6.6
0.4	4004	175	66	-26
0.3	13347	891	348	163
0.2	45545	3354	1725	940
-0.2	10537	901	474	317
-0.3	1965	155	71	51
-0.4	367	24	13.7	10.6
-0.5	78	4.3	3.5	3.0
HOURS:	10767	2319	21612	1845

HOURS REFERS TO AMOUNT OF RECORDED DATA

REFERENCE: C-141A, (WRAMA-70-WRNE-282), (ASD-TR-69-10), (ASD-TR-67-1)

32

TABLE 8

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

CARGO CLASS

LOGISTICS MISSION PHASE DATA

ΔNZ	LOGISTICS <4 HRS ASCENT	LOGISTICS <4 HRS CRUISE	LOGISTICS <4 HRS DESCENT	LOGISTICS 4-10 HRS ASCENT	LOGISTICS 4-10 HRS CRUISE	LOGISTICS 4-10 HRS DESCENT
1.6						
1.4						
1.2						
1.0						
0.9						
0.8	7.6		3.6	1.9	.2	
0.7	12.4		7.8	6.2	.8	
0.6	27	7.9	21.7	20.9	3.0	10.1
0.5	110	23	105	62	7.2	51
0.4	474	83	485	277	25	311
0.3	2721	373	2485	1555	127	1732
0.2	10326	1402	9276	7342	635	7518
-0.2	2740	384	2477	1951	164	2140
-0.3	436	81	359	267	27	288
-0.4	76	12.9	47	42	5.6	38
-0.5	19.0	2.8		11.4	1.3	6.3
-0.6						
HOURS:	264	1779	276	1051	13347	794

REFERENCE: C-141A (WRAMA-70-MRNR=282) (ASD-TR 69-10)

HOURS REFERS TO AMOUNT OF RECORDED DATA

33

TABLE 9

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

CARGO CLASS   TRAINING MISSION PHASE DATA

ΔNZ	ASCENT	CRUISE	DESCENT
1.6			6.4
1.4	1.9		15.5
1.2	5.6		39
1.0	18.5	5.6	104
0.9	37	17.5	180
0.8	90	42	287
0.7	194	158	479
0.6	521	609	793
0.5	1500	1400	1500
0.4	4444	4489	3551
0.3	18294	13934	11849
0.2	62836	43302	37499
-0.2	23840	7167	9646
-0.3	5325	1229	1878
-0.4	1089	198	404
-0.5	227	32	98
-0.6			
HOURS:	866	3400	1501

REFERENCE: C-141A, (WRAMA-70-WRNE-282), (ASD-TR-69-10)
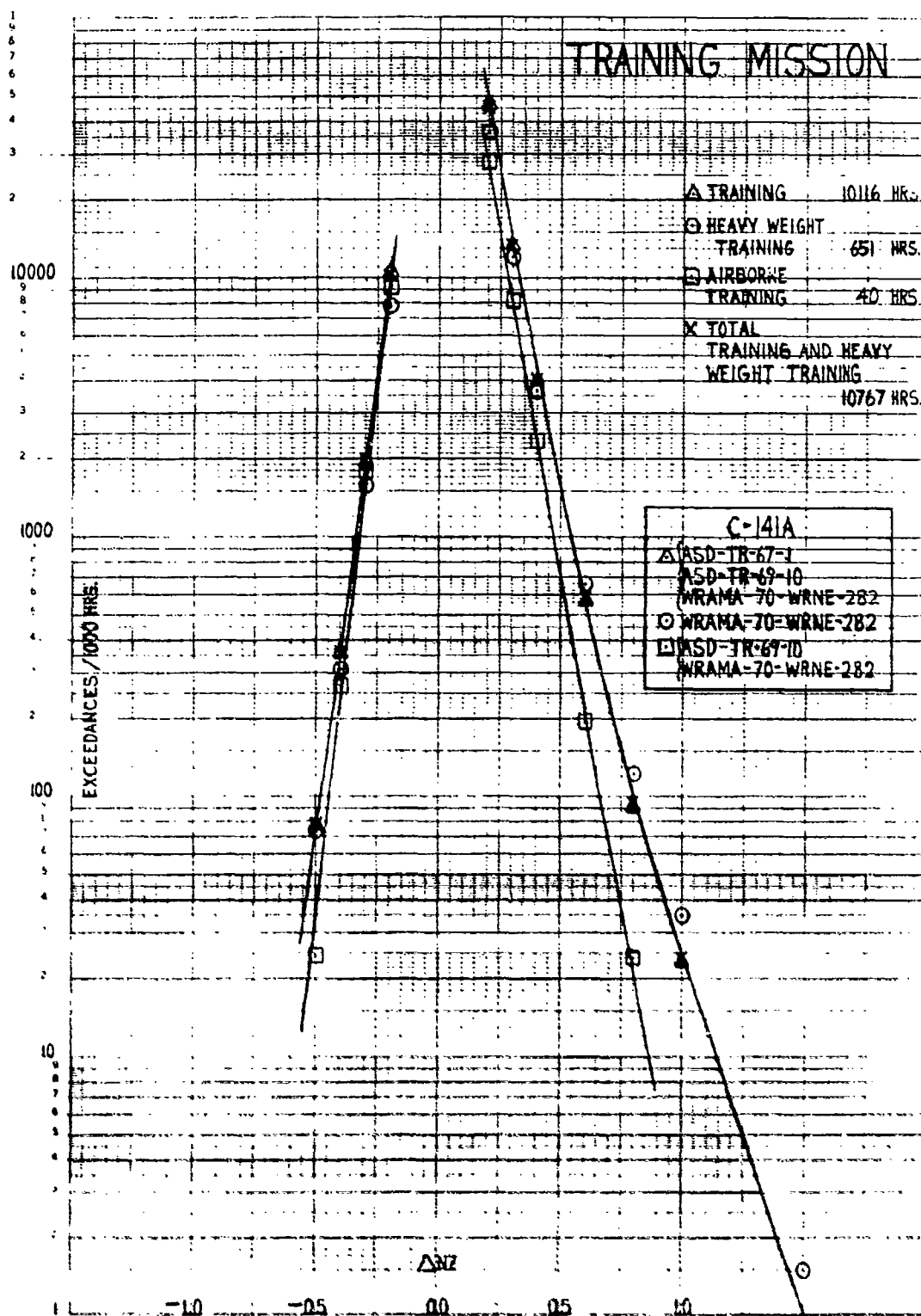
HOURS REFERS TO AMOUNT OF RECORDED DATA

34

FIGURE 21

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FIGURE 22

36

FIGURE 23

37

FIGURE 24

38

FIGURE 25

39

FIGURE 26

40

FIGURE 27

41

FIGURE 28

42
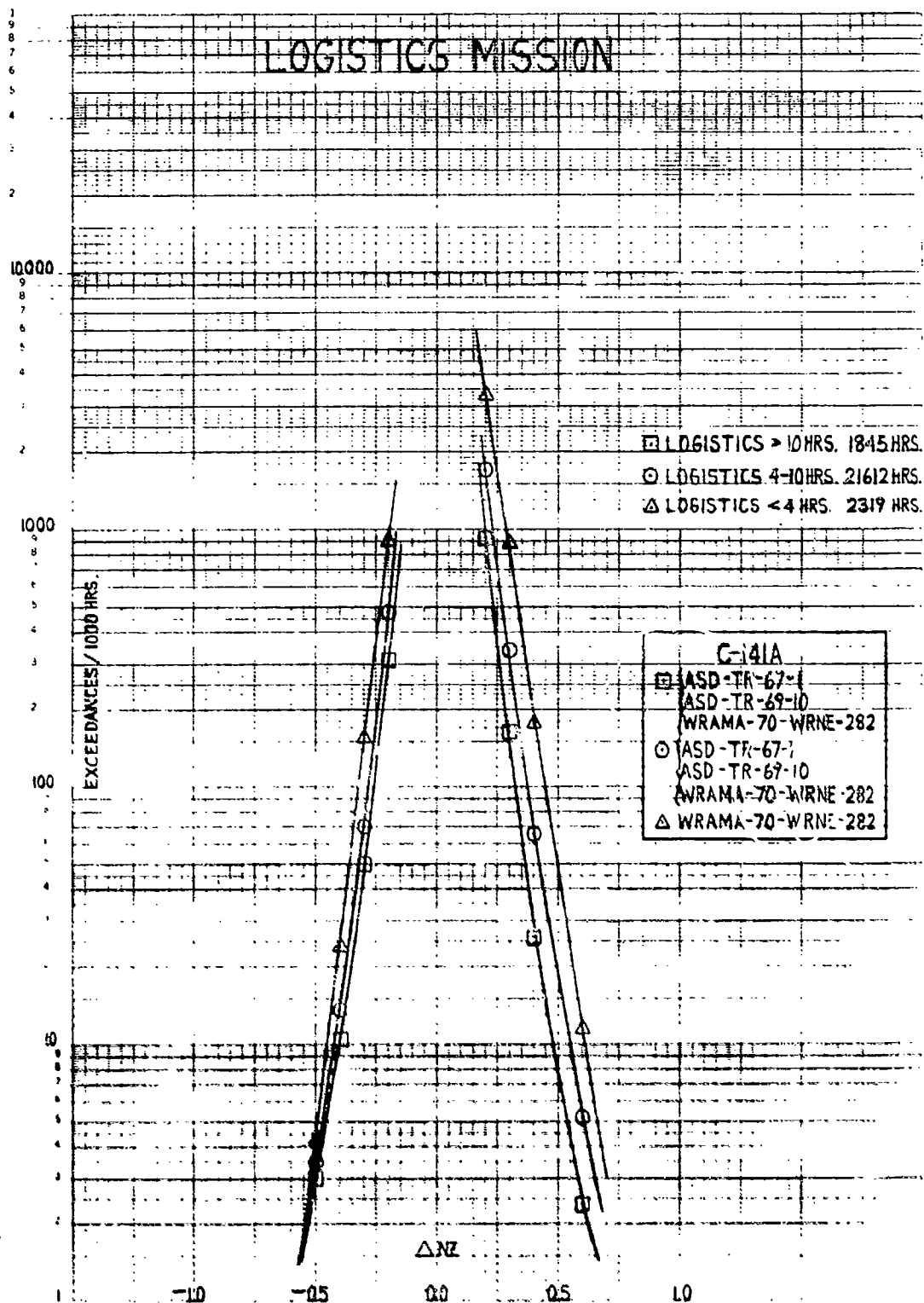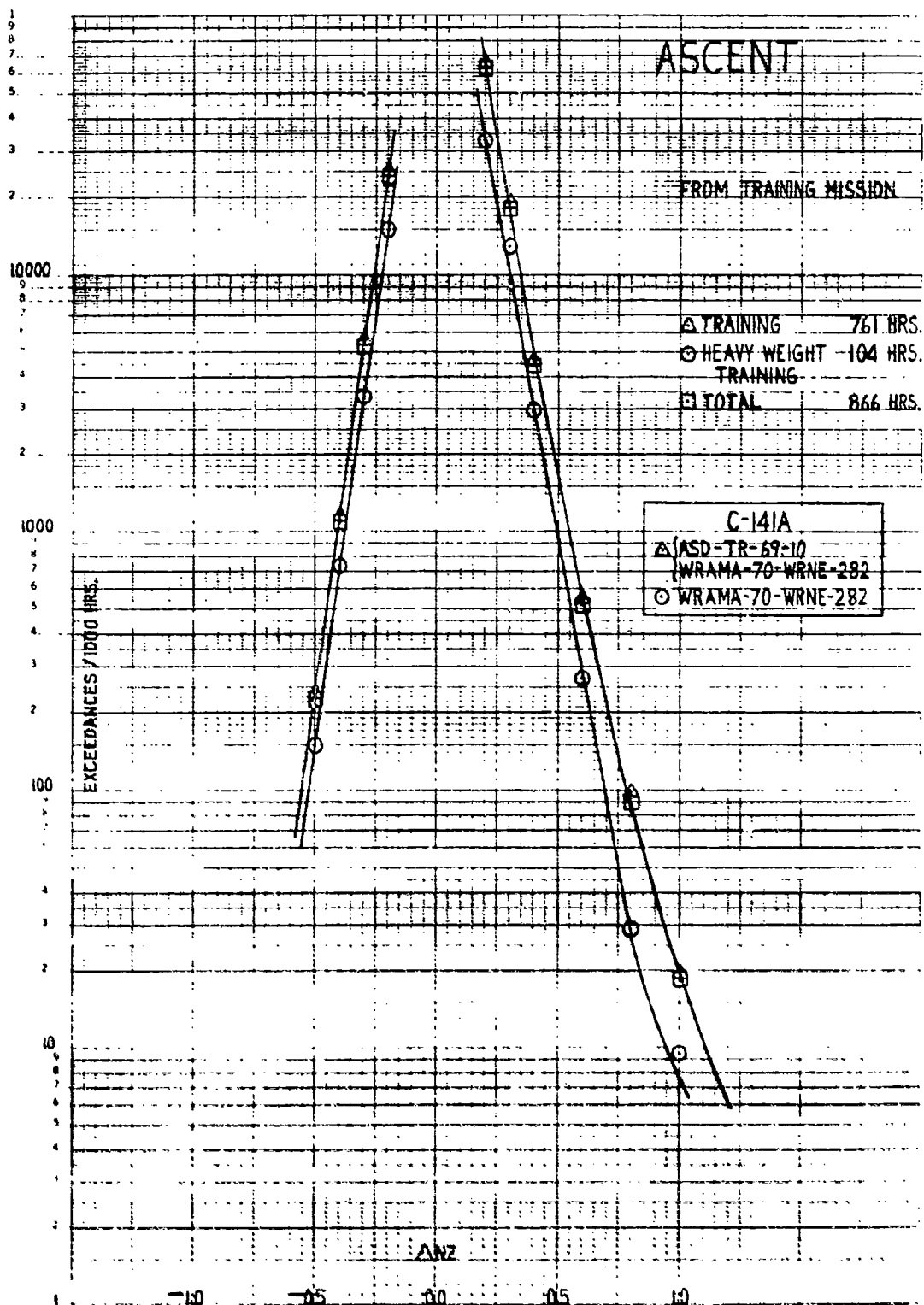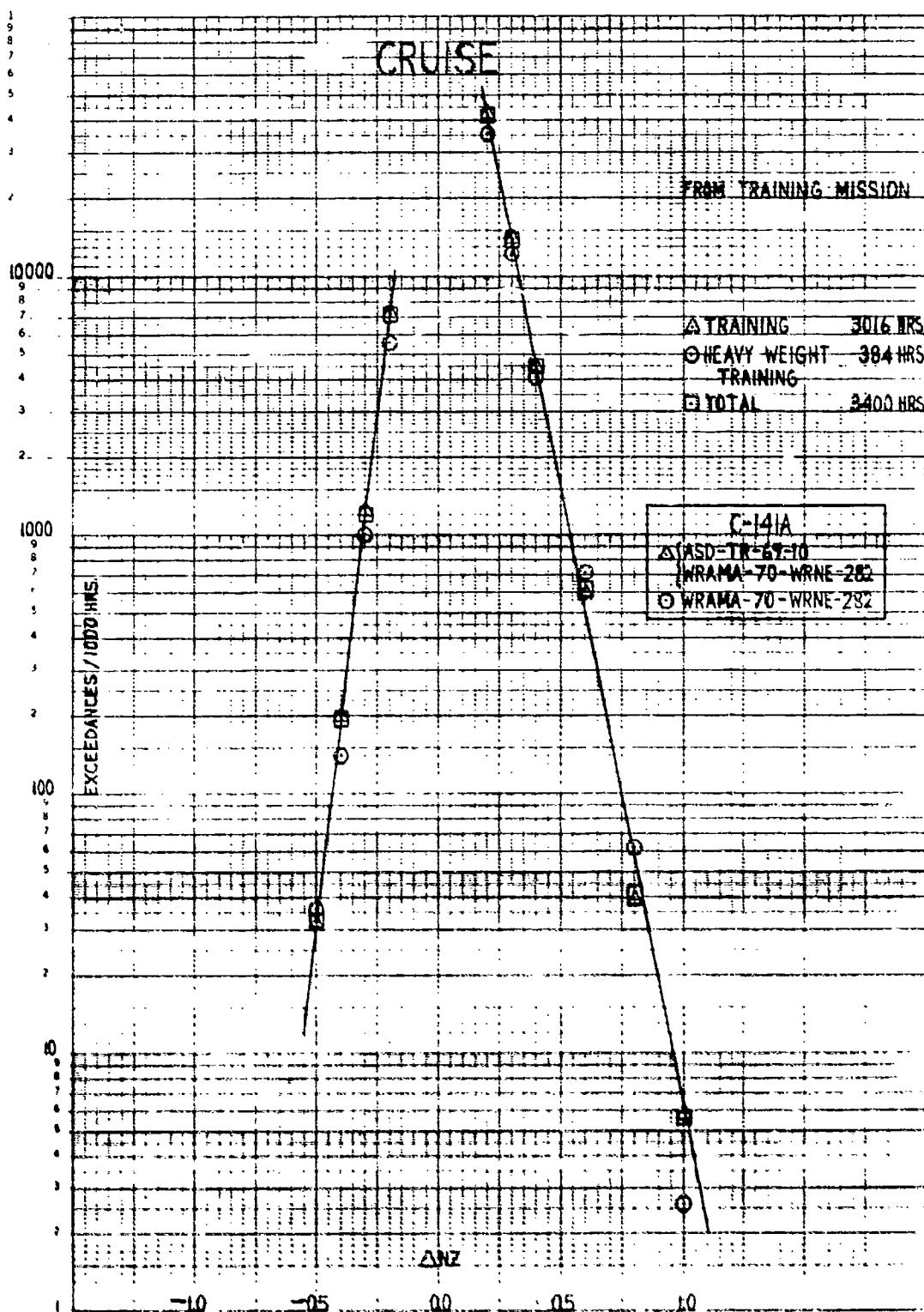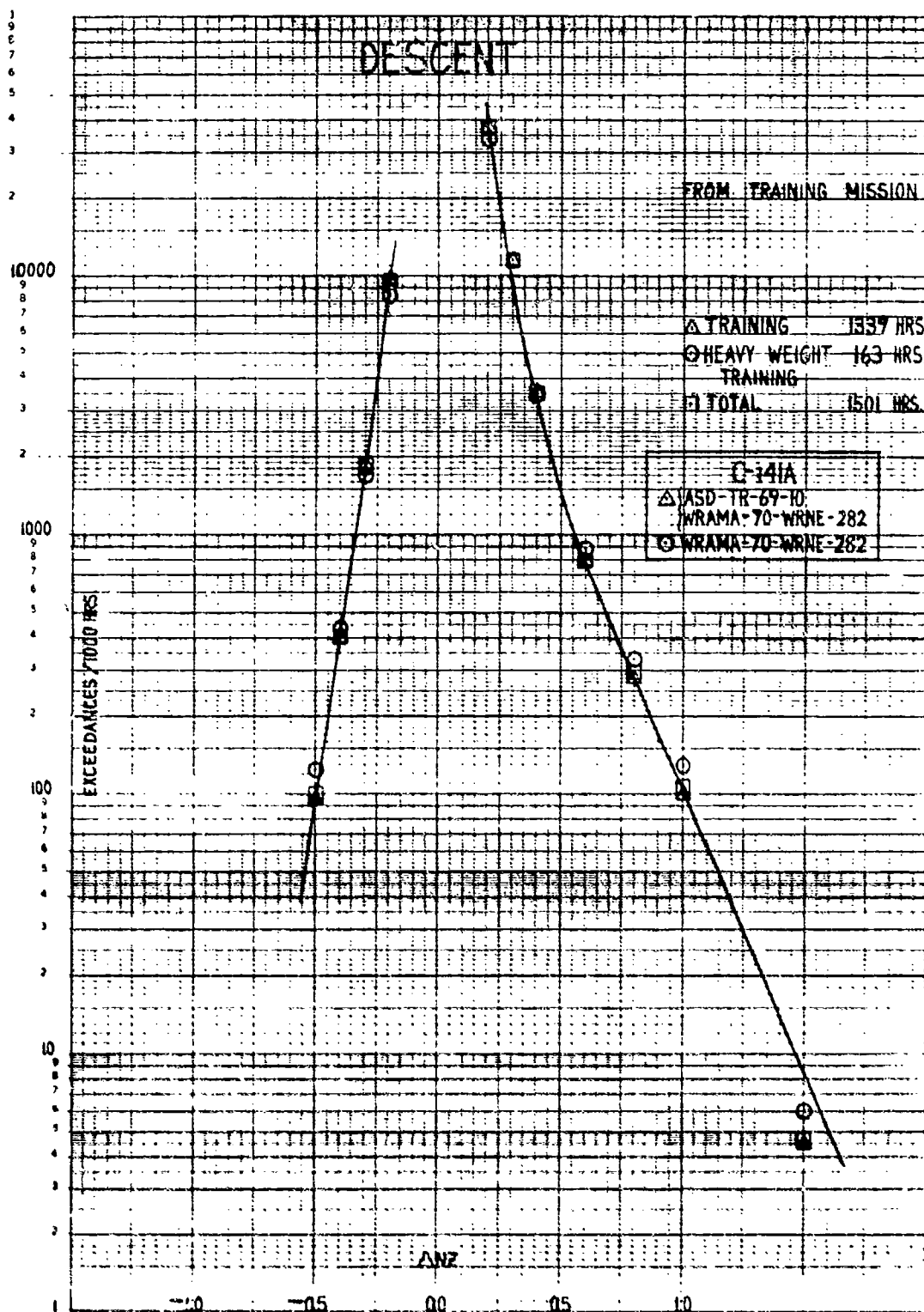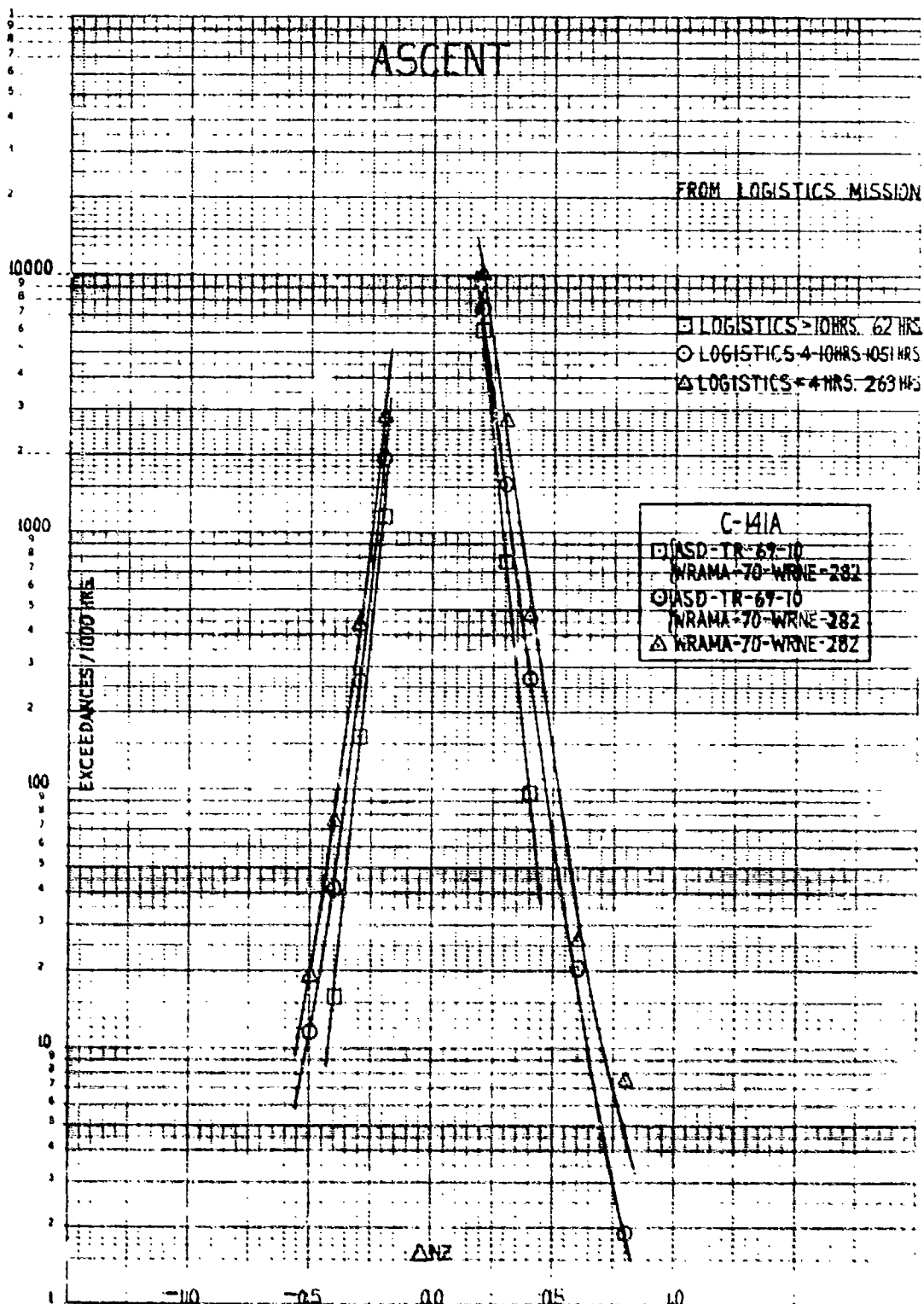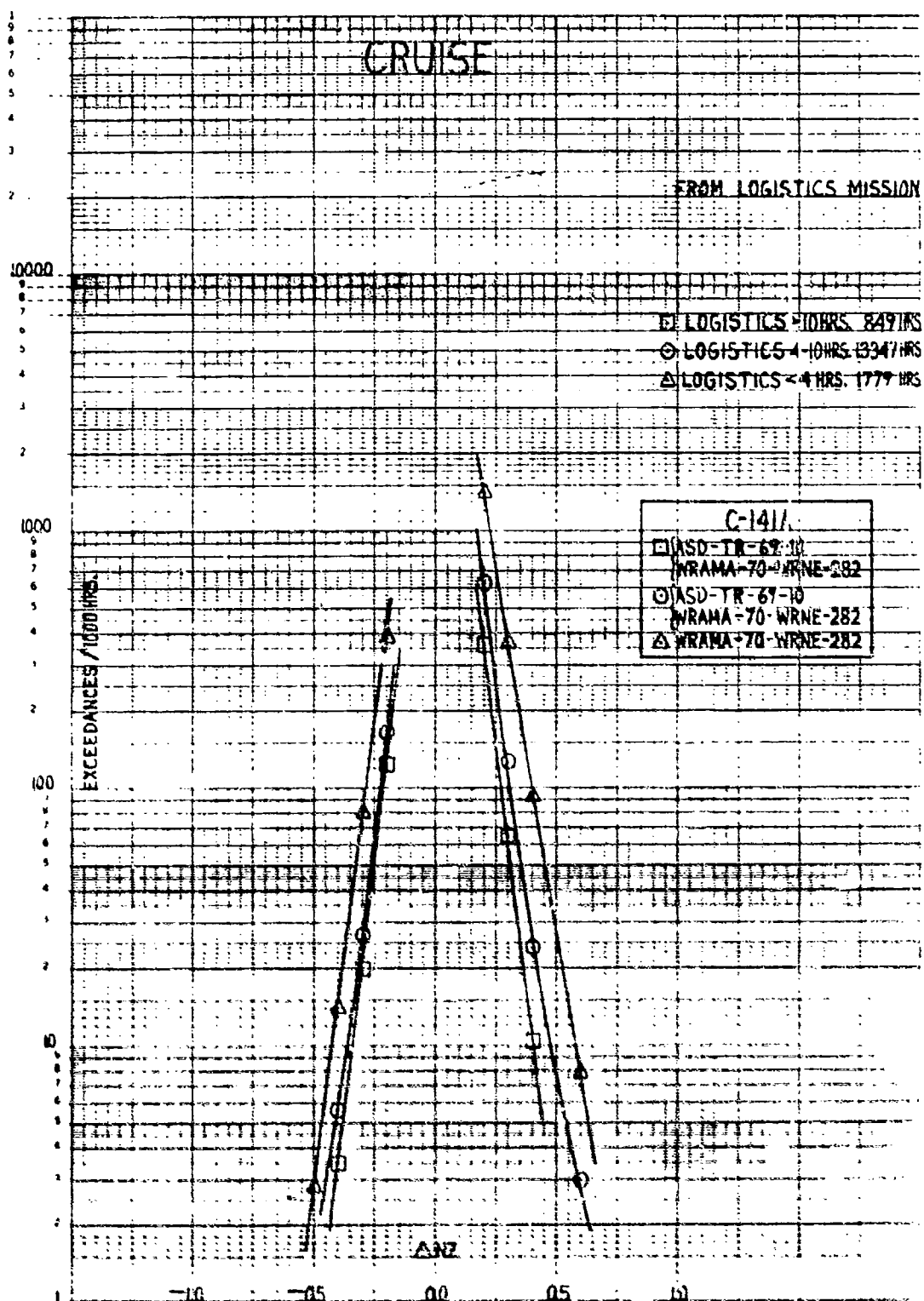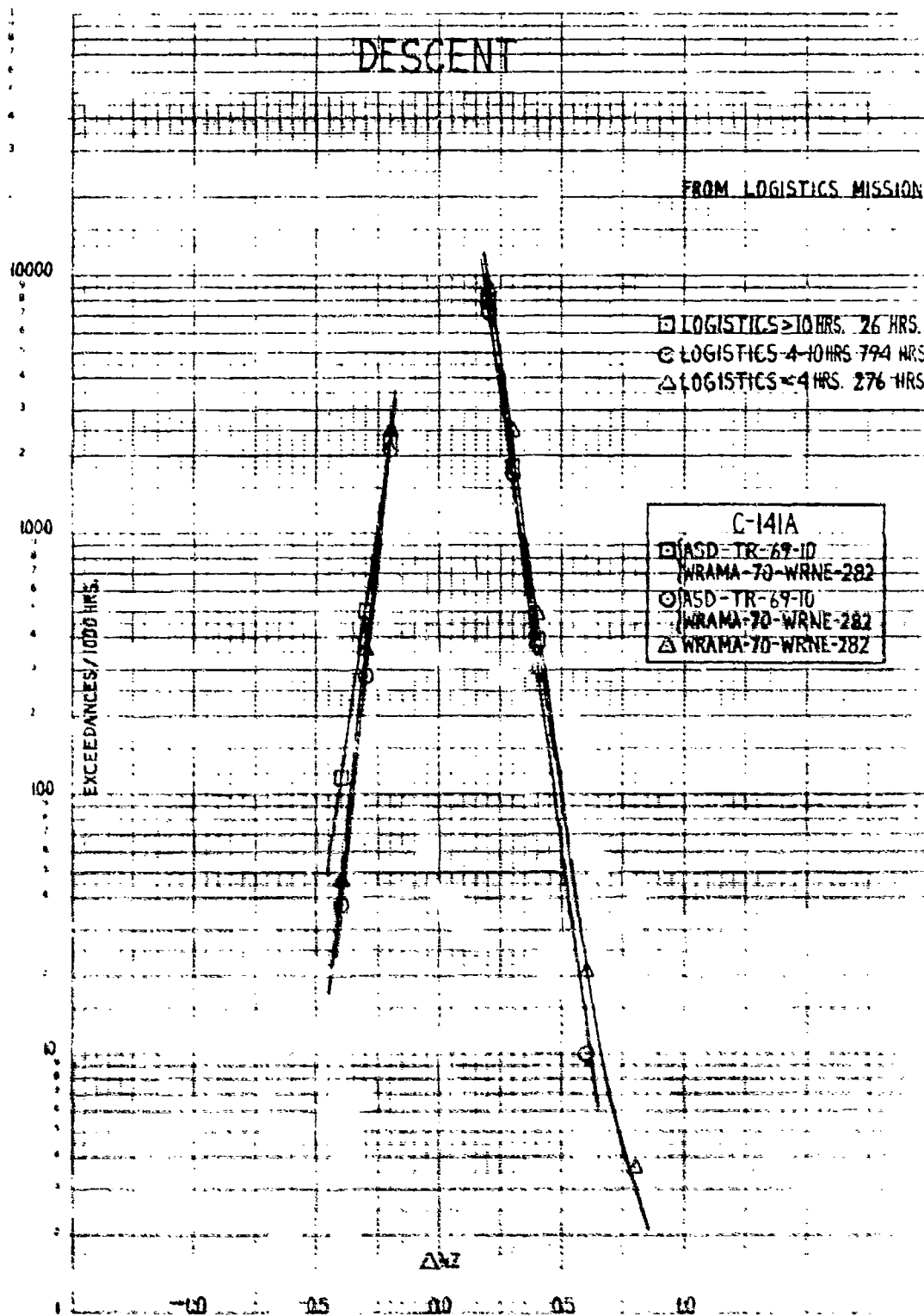
TABLE 10

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

	CARGO CLASS		MISSION DATA	
ΔNZ	TRAINING	LOGISTICS SHORT RANGE	LOGISTICS MEDIUM RANGE	LOGISTICS LONG RANGE
1.0				
0.9				
0.8				
0.7				
0.6	4			
0.5	46	7	10	2
0.4	320	75	38	11
0.3	2400	390	210	125
0.2	15000	2400	1050	740
-0.2	6400	1400	560	450
-0.3	980	175	85	63
-0.4	130	35	18	4
-0.5	29	5	3	
-0.6	8	2		
-0.7				
-0.8				
HOURS:	237	504	1202	547

REFERENCE: C-5A, (LOCKHEED LG1GES-357/0-4)

HOURS REFERS TO AMOUNT OF RECORDED DATA

43

TABLE 11

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

LOGISTICS MISSION PHASE DATA WITH AERIAL REFUELING

CARGO CLASS

ΔNZ	ASCENT	CRUISE	DESCENT	AERIAL REFUELING
1.0				2
0.9				7
0.8				23
0.7				82
0.6				290
0.5	19	5	25	1250
0.4	51	33	130	4200
0.3	430	190	1150	16000
0.2	3600	1150	5400	93000
-0.2	1750	720	2200	93000
-0.3	320	96	300	16000
-0.4	38	20	33	4200
-0.5	5	4	17	1230
-0.6			9	285
-0.7				95
-0.8				23
HOURS:	204	2268	119	136

HOURS REFERS TO AMOUNT OF RECORDED DATA

REFERENCE: C-5A, (LOCKHEED LDIGI-S-3570-4), (LOCKHEED LG77ER011)

44

FIGURE 29

45

LOGISTICS MISSION

EXCEEDANCES / 1200 HRS.

△ LOGISTICS SHORT RANGE 504 HRS
○ LOGISTICS MEDIUM RANGE 1202 HRS
□ LOGISTICS LONG RANGE 547 HRS

C-5

△
○ LDIGI-S-3570-4
□

JULY 1976

ΔNZ

-1.0   -0.5   0.0   0.5   1.0

FIGURE 30

46

FIGURE 31

47

FIGURE 32

48

FIGURE 33

49

FIGURE 34

50
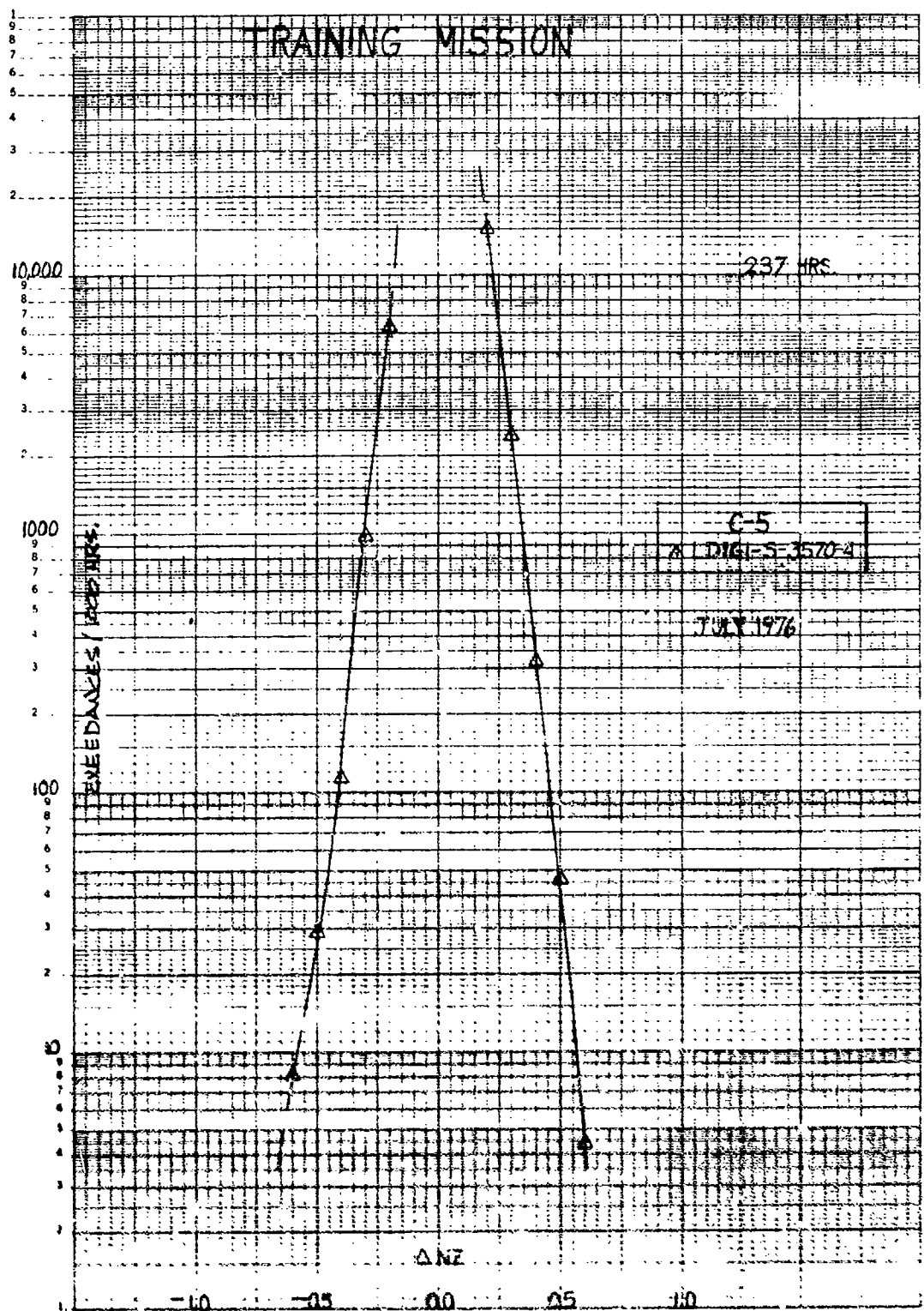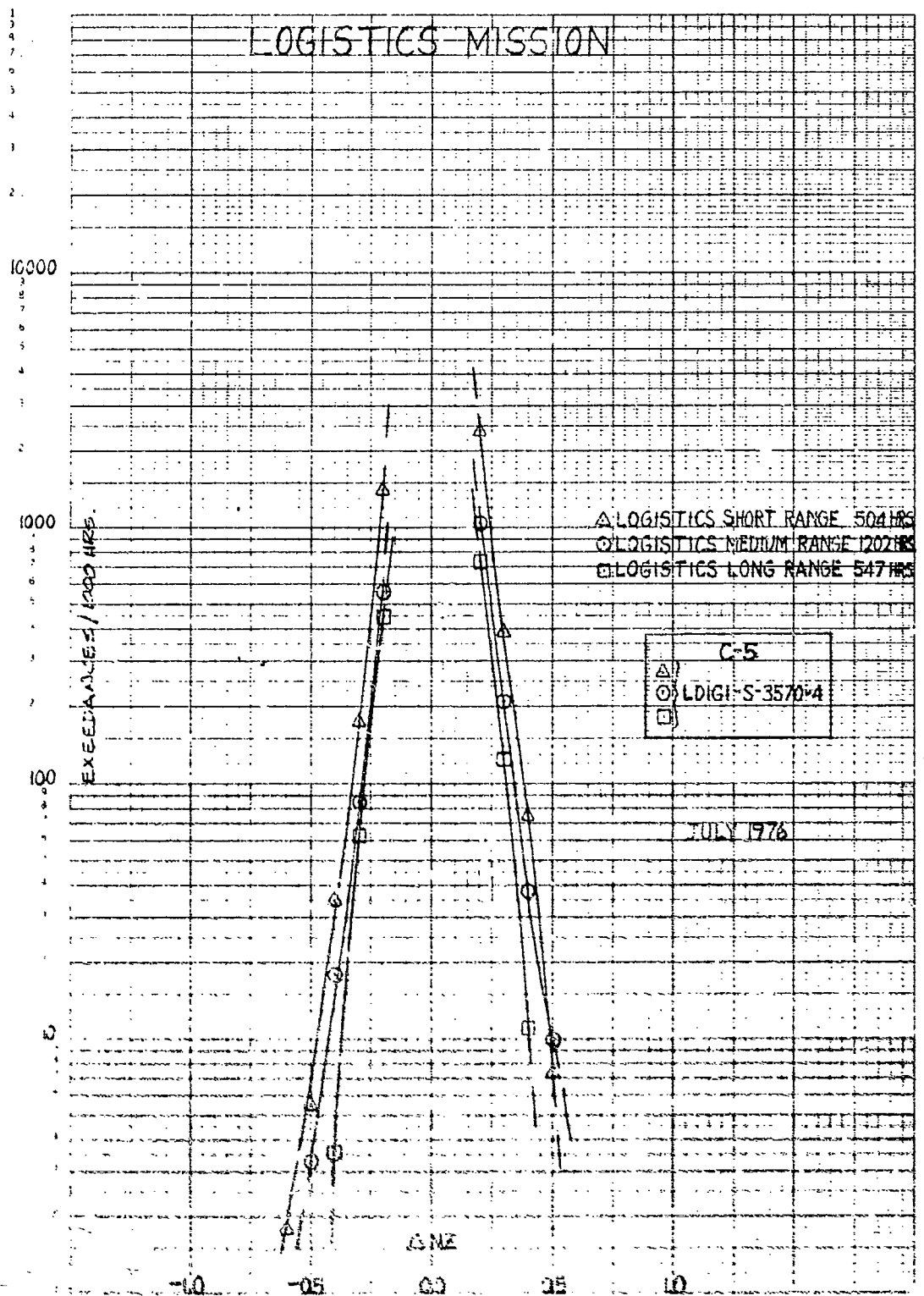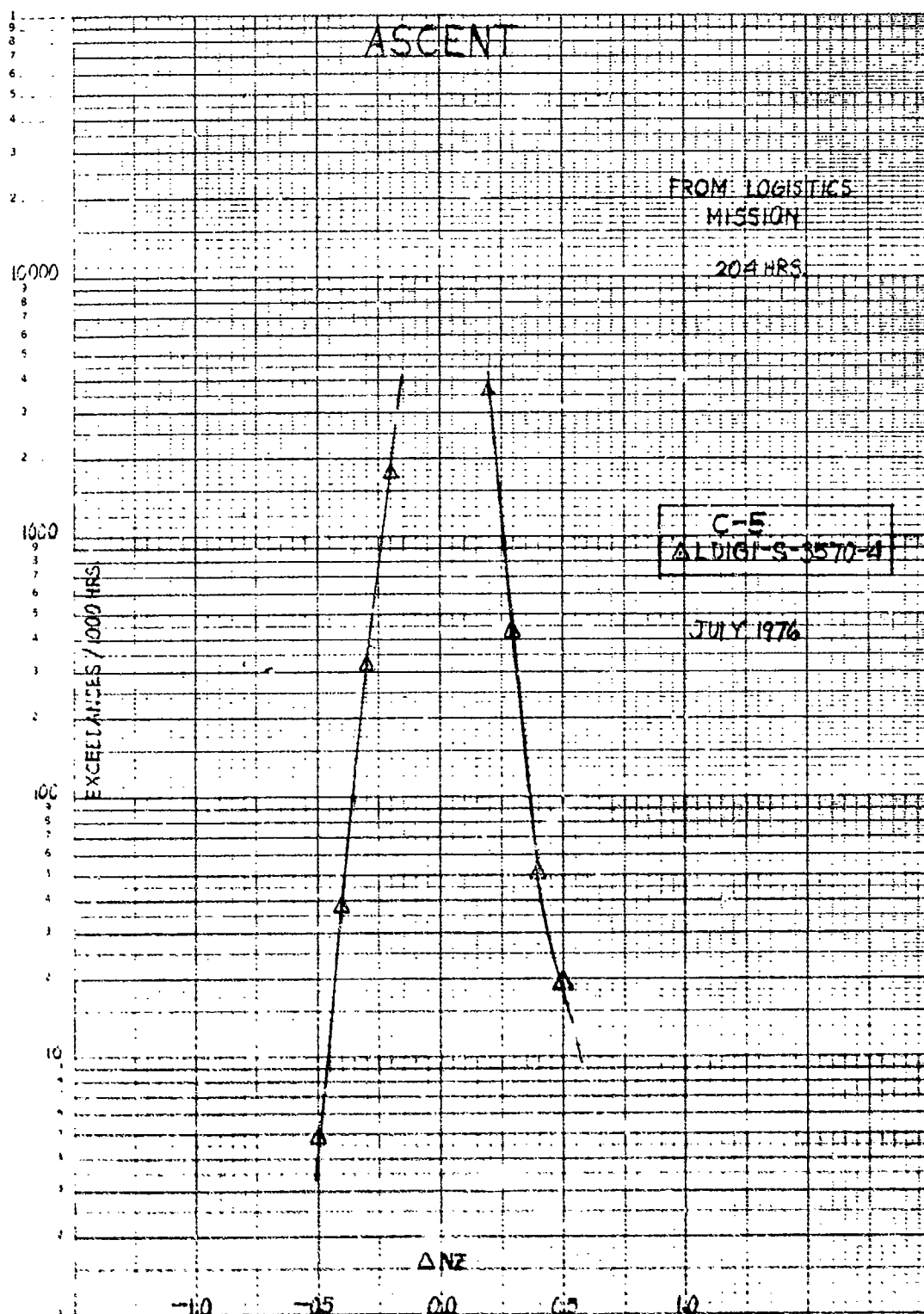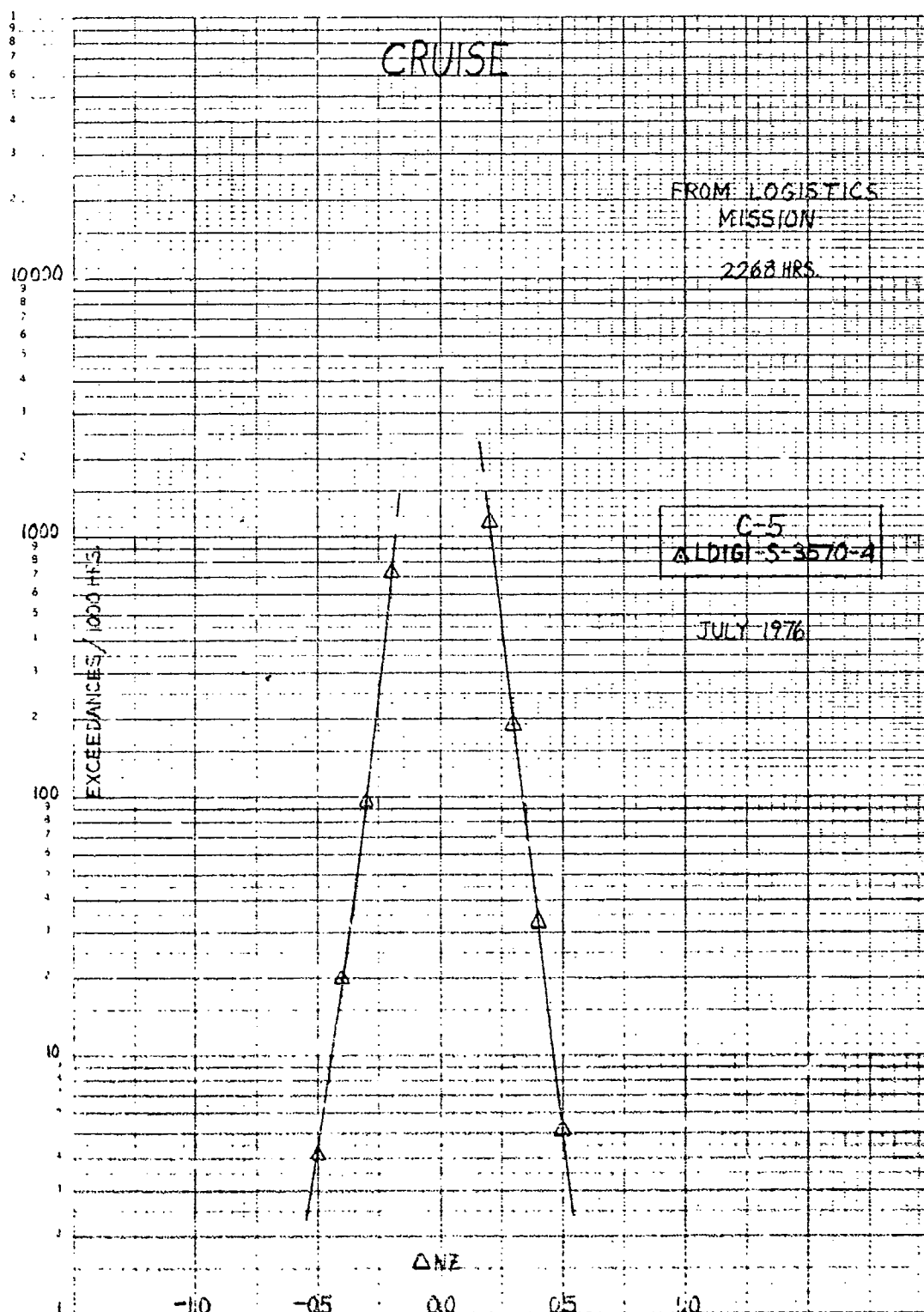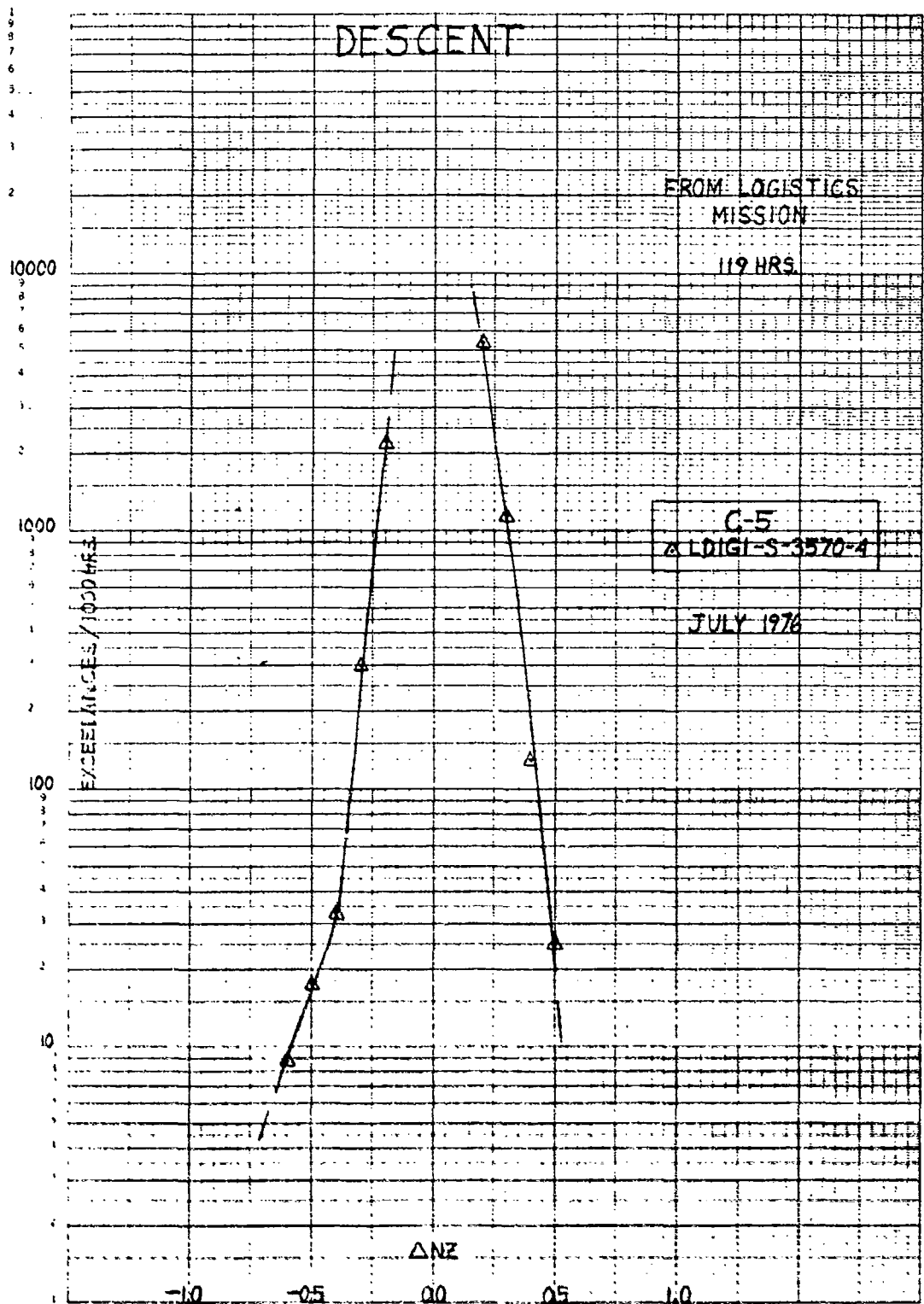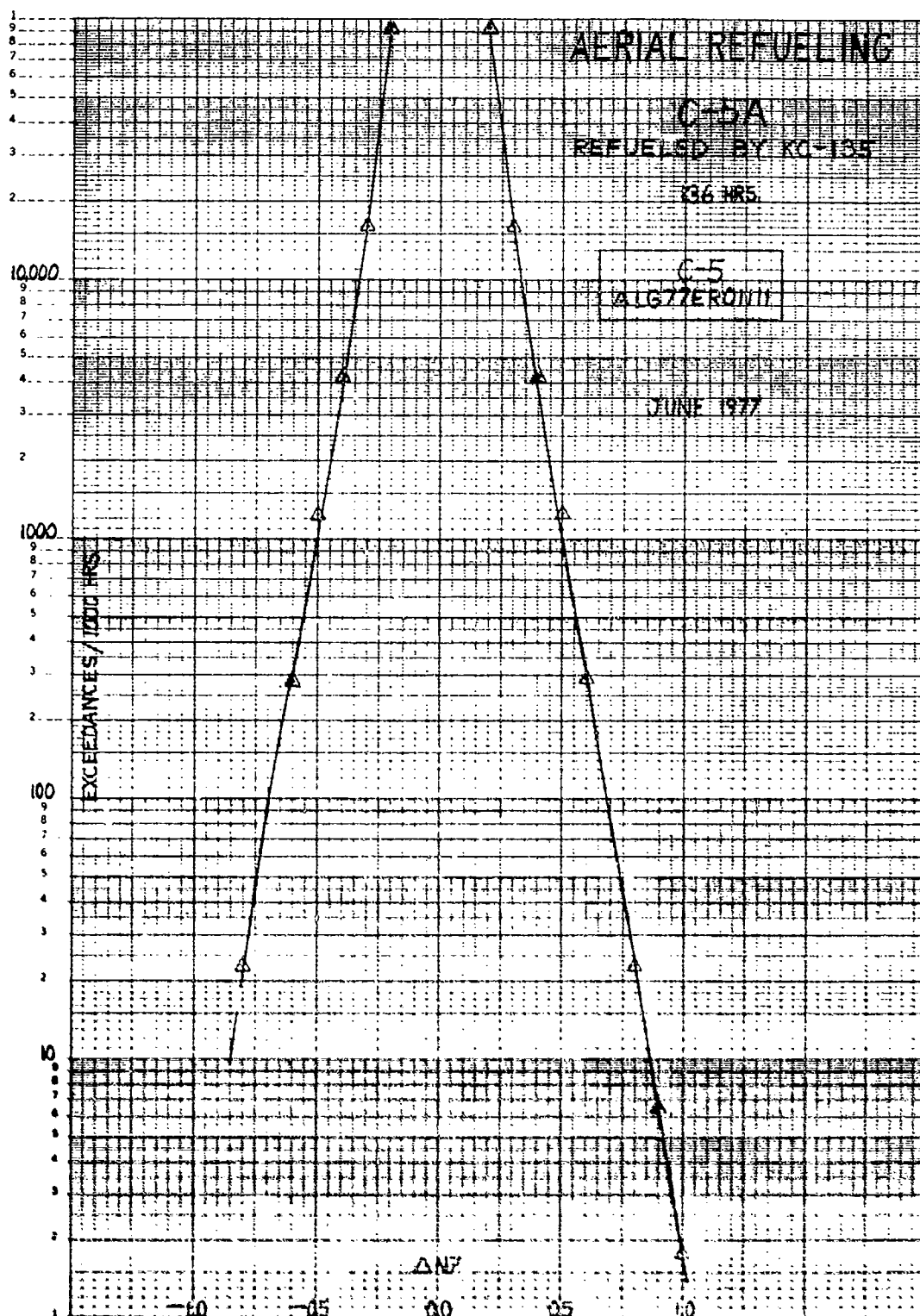
TABLE 12

MANEUVER NZ EXCEEDANCES PER 1000 FLIGHTS

	CARGO CLASS		GROUND DATA		
NZ	LANDING IMPACT 6935 FLIGHTS	TAXI 6264 FLIGHTS	TAKE-OFF RUN 3348 FLIGHTS	LANDING ROLL-OUT 3242 FLIGHTS	TOUCH-AND-GO ROLL 3693 FLIGHTS
1.0	4.9		.6		.3
0.9	7.7		1.4		.7
0.8	17.4		3.4		2.0
0.7	36		9.3	3.1	5.4
0.6	85		24	12.0	14.5
0.5	201	.5	72	47	37
0.4	508	8.6	223	197	133
0.3	1280	35	867	1040	691
0.2	4090	314	5910	6830	5470
-0.2	2410	217	5400	5700	4770
-0.3	580	17.9	988	712	766
-0.4	179	3.0	296	132	189
-0.5	67	.6	111	36	60
-0.6	26		45	11.7	23
-0.7	11.1		18.2	4.9	10.3
-0.8	5.1		8.2		4.6
-0.9	2.6		4.0		2.4
-1.0	1.4		2.1		1.4
HOURS:	5.8	.764	28.5	46.2	20.2

HOURS REFERS TO AMOUNT OF RECORDED DATA

51

LANDING IMPACT

MISSION PHASE   5.8 HRS

C-141A
△ASD-TR-69-0

PHASE IS DEFINED AS THE
FIRST 3 SECONDS AFTER
INITIAL CONTACT OF THE
LANDING GEAR WITH THE
RUNWAY

6935 FLIGHTS

EXCEEDANCES/FLIGHT

ΔNZ

FIGURE 35

52

TAKE-OFF RUN

MISSION PHASE 28.5 HRS.

C-141A
△ ASD-TR-69-10

PHASE IS DEFINED AS THE
PERIOD OF TIME AT WHICH
THE AIRCRAFT'S GROUND
SPEED EXCEEDS 20 KNOTS
UNTIL LIFT-OFF

3348 FLIGHTS

AVE. TIME/FLT. 32.6 SEC.

FIGURE 36

63

LANDING
ROLL - OUT

MISSION PHASE 46.2 HRS.

C-141A
△ ASD-TR-69-10

PHASE IS DEFINED AS THE
PERIOD OF TIME FROM THE
END OF THE LANDING IM-
PACT MISSION PHASE UNTIL
THE AIRCRAFT'S GROUND
SPEED FALLS BELOW 20
KNOTS

3242 FLIGHTS
AVE. TIME/FLT. 51.3 SEC.

EXCEEDANCES / FLIGHT

ΔNZ
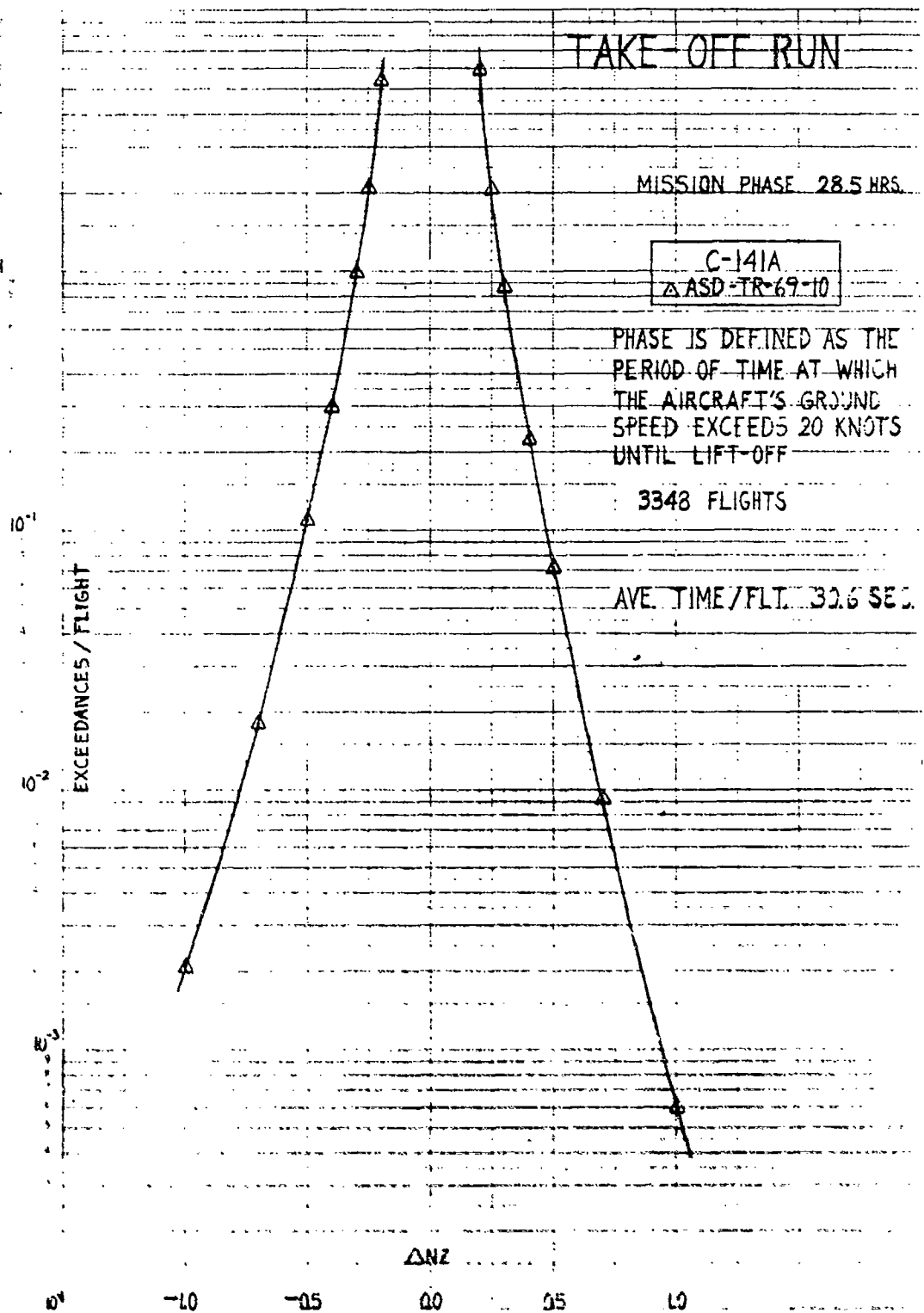
FIGURE 37

54

FIGURE 38

55

FIGURE 39

TABLE 13

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

	FIGHTER CLASS			MISSION DATA		
NZ	F-4C/D AIR TO AIR	F-4C/D AIR TO GROUND	F-4C/D INST & NAV.	F-4E AIR TO AIR	F-4E AIR TO GROUND	F-4E INST & NAV.
8.0	17	3		55	2	
7.5	50	11	1	133	10	
7.0	140	40	2	309	47	
6.5	336	130	6	684	175	82
6.0	857	400	15	1420	500	170
5.5	1820	1110	36	2702	1200	320
5.0	3260	2630	85	4563	2430	525
4.5	5355	5100	191	6688	4400	840
4.0	7664	8300	395	9913	7400	1340
3.5	11160	13500	778	14594	11600	2150
3.0	16500	21500	1615	21100	18100	3600
2.5	24680	32630	3470	29231	27000	5500
2.0	37080	44800	7684	37147	40500	8700
0.0	3400	820	195	5200	1400	680
-0.5	550	90	11	1267	170	92
-1.0	130	16	1	316	29	16
-1.5	40	4		86	1	7
-2.0	11	2		26		2
-2.5	5	1		9		
-3.0	2			3		
HOURS:	2016	1900	1096	562	1053	249

HOURS REFERS TO AMOUNT OF RECORDED DATA

REFERENCE: F-4C/D, F-4E, (ASIMIS REPORT, 1973-4, 1974-5)

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TABLE 14

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

FIGHTER CLASS   MISSION PHASE DATA

NZ	ASCENT	CRUISE/INTERCEPT	CRUISE	MANEUVER AIR TO AIR	MANEUVER AIR TO GROUND	MANEUVER RECON, INST & NAV & TEST
8.0				56	9	11
7.5				150	30	46
7.0				380	100	114
6.5				945	320	290
6.0		4		2240	980	730
5.5		11		4900	2790	1850
5.0		30		9570	7020	4150
4.5		90	36	16270	15320	8300
4.0	3	260	105	22210	26620	14300
3.5	37	750	310	31600	38580	22500
3.0	180	2180	903	44970	55490	33705
2.5	880	5920	2450	63260	77950	50500
2.0	4470	13790	5730	86070	103770	74000
0.0				8300	1880	4200
-0.5				1630	370	880
-1.0				390	90	189
-1.5				110	25	43
-2.0				36	8	10
-2.5				13	3	
-3.0				5	1	
HOURS:	272	665	1777	685	716	106

REFERENCE: F-4C/D (ASIMIS REPORT 19/3-74)   HOURS REFERS TO AMOUNT OF RECORDED DATA

58

TABLE 15

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

FIGHTER CLASS   CONUS MISSION PHASE DATA

NZ	PRACTICE LANDING	DESCENT				
8.0						
7.5						
7.0						
6.5						
6.0						
5.5		2				
5.0	5	37				
4.5	12	307				
4.0	30	894				
3.5	85	2000				
3.0	260	4246				
2.5	880	7992				
2.0	3560					
	18060					
0.0						
-0.5						
-1.0						
-1.5						
-2.0						
-2.5						
-3.0						
HOURS:	476	714				

HOURS REFERS TO AMOUNT OF RECORDED DATA

REFERENCE: F-4C/D (ASIMIS REPORT 1973-74)

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MANEUVER NZ EXCEEDANCES PER 1000 HOURS

SEA MISSION DATA

FIGHTER CLASS

NZ	RECONNAISSANCE					
7.0	1					
6.5	6					
6.0	23					
5.5	61					
5.0	130					
4.5	255					
4.0	510					
3.5	1150					
3.0	2300					
2.5	5650					
2.0						
0.0	200					
-0.5	15					
-1.0	4					
-1.5	1					
HOURS:	1217					

60

REFERENCE: RF-4C ASD-TR-74-2

HOURS REFERS TO AMOUNT OF RECORDED DATA

FIGURE 40

61

FIGURE 41

62

INSTRUMENTS and NAVIGATION
MISSION

F-4C/D
UNSLATTED
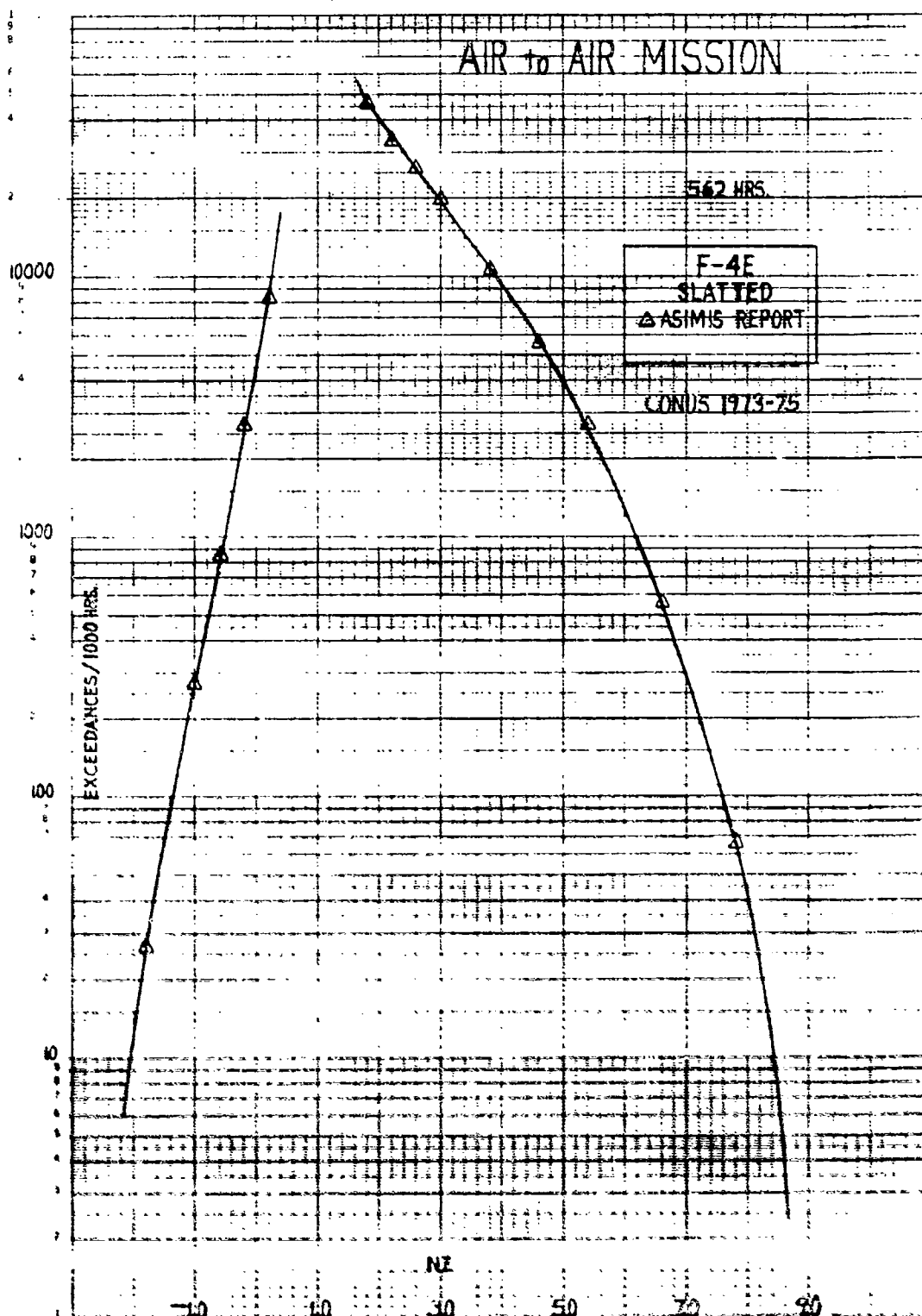△ ASIMIS REPORT

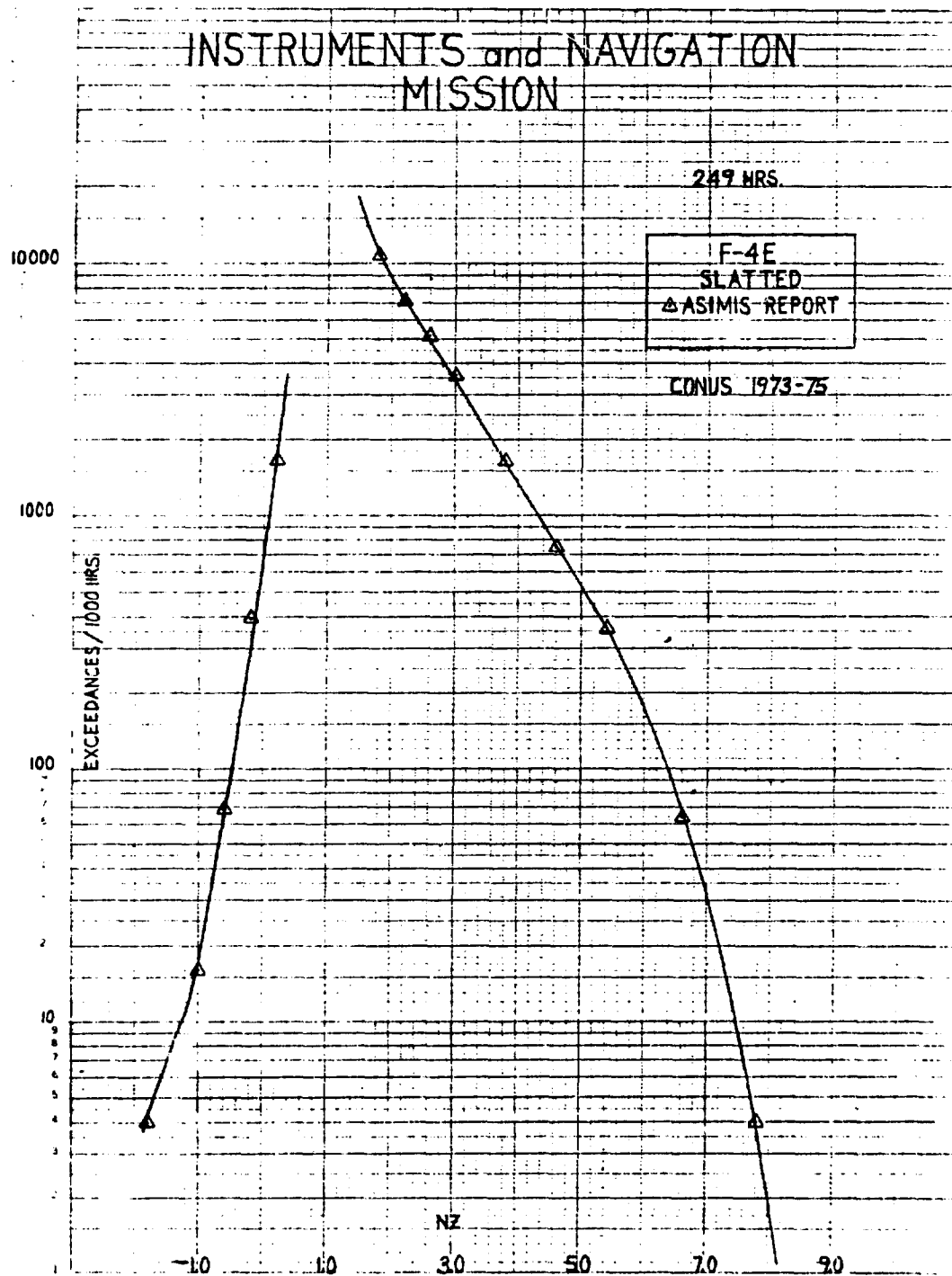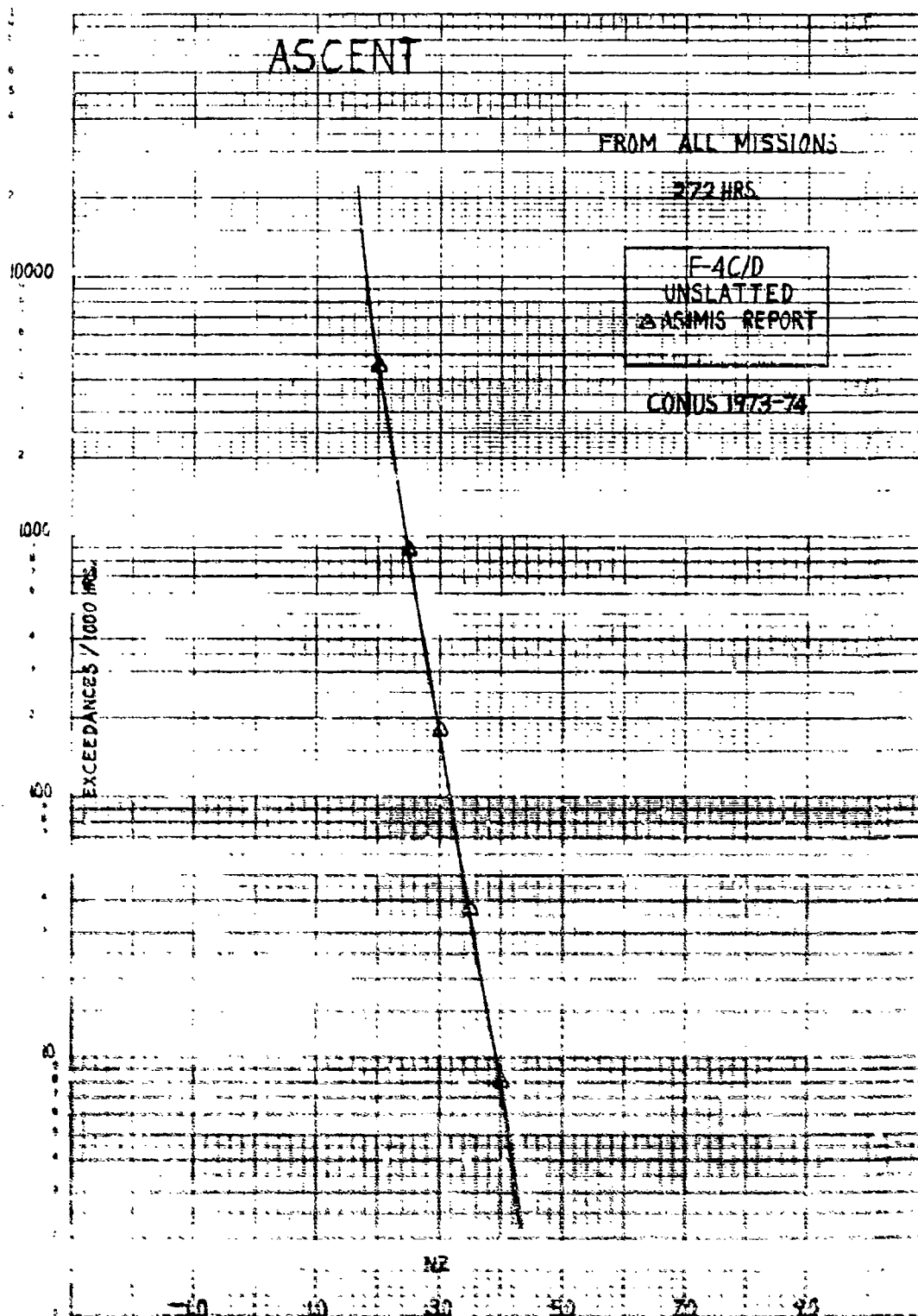1096 HRS.

CONUS 1973-74

FIGURE 42

63

FIGURE 43

64

FIGURE 44

65
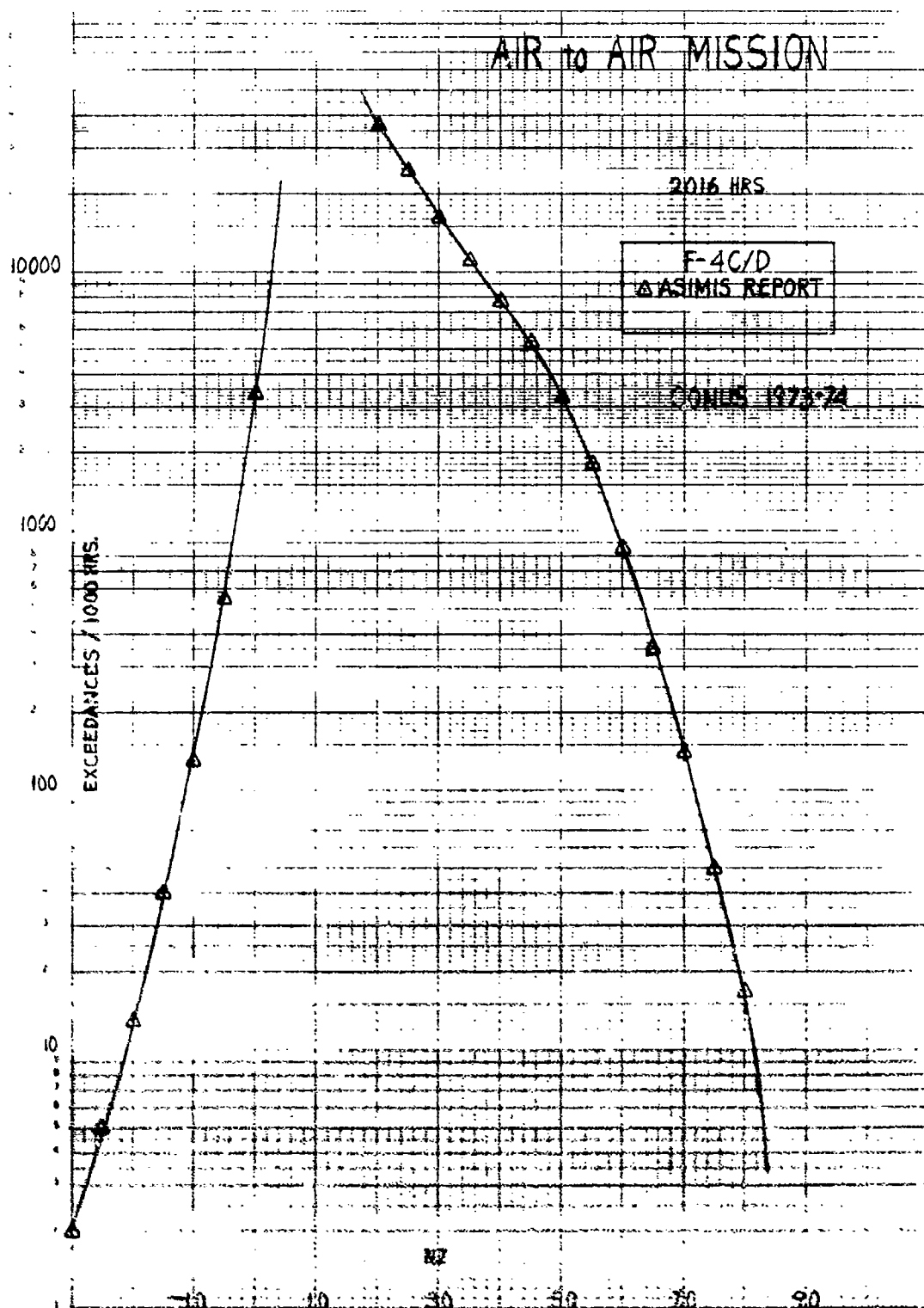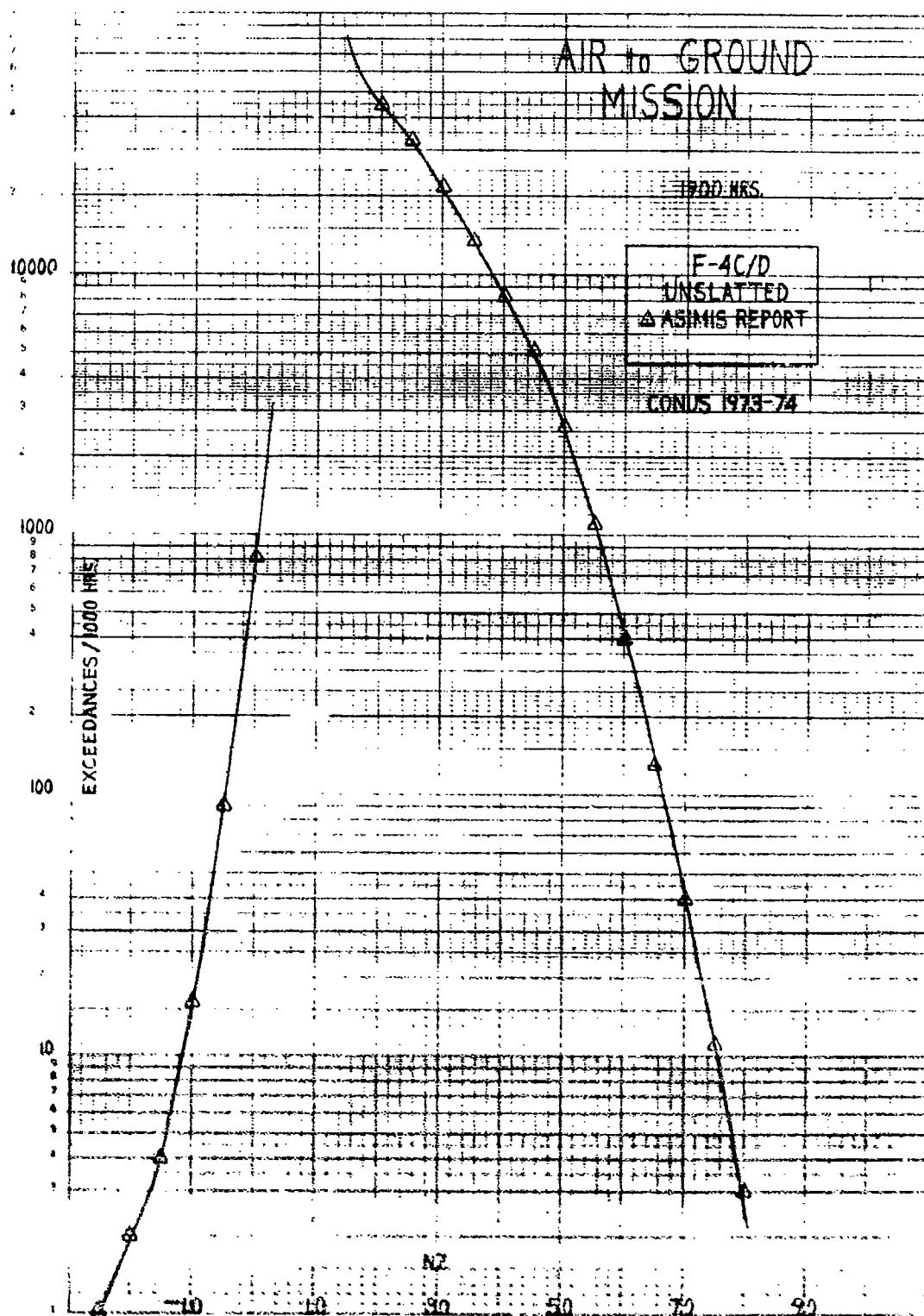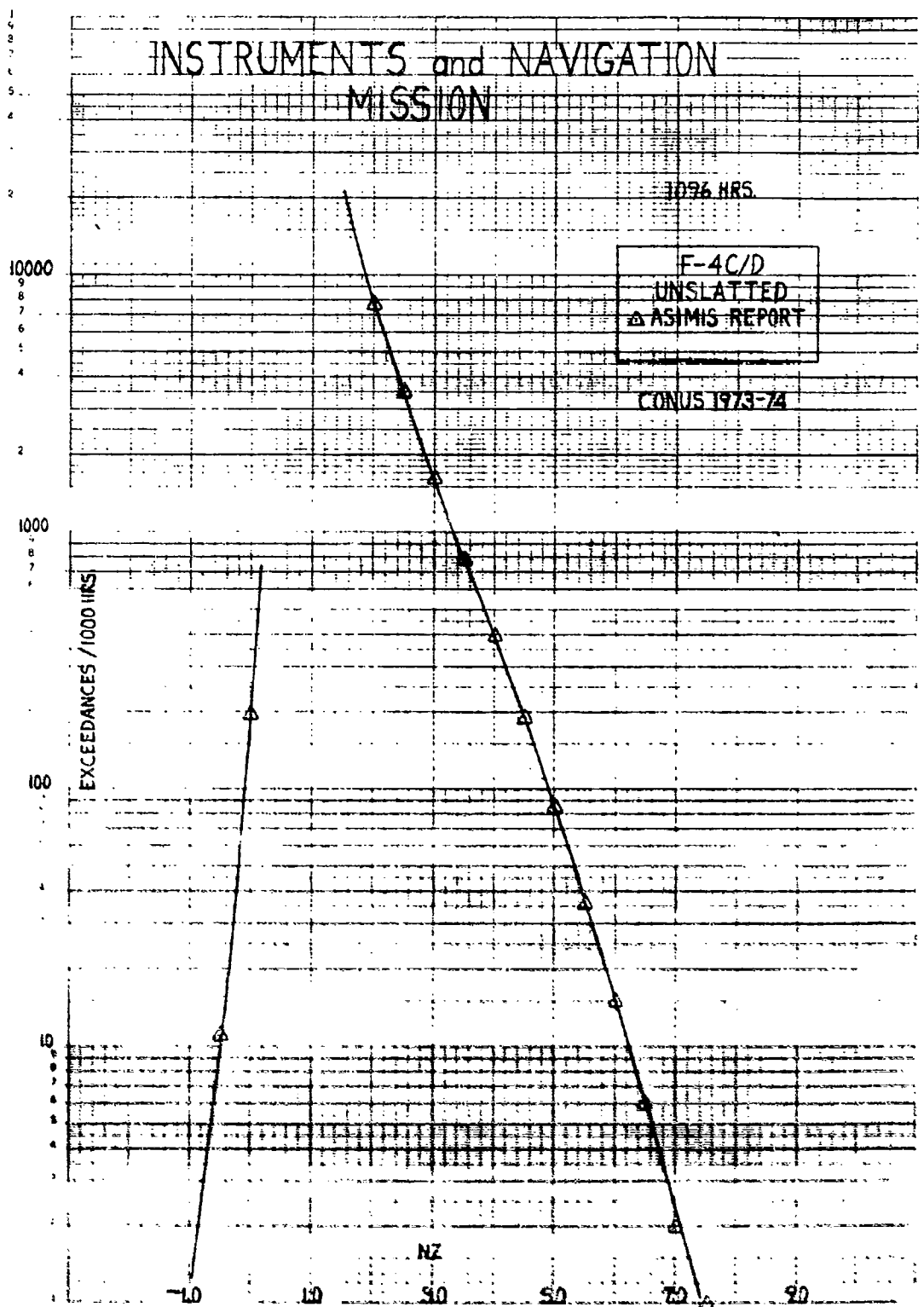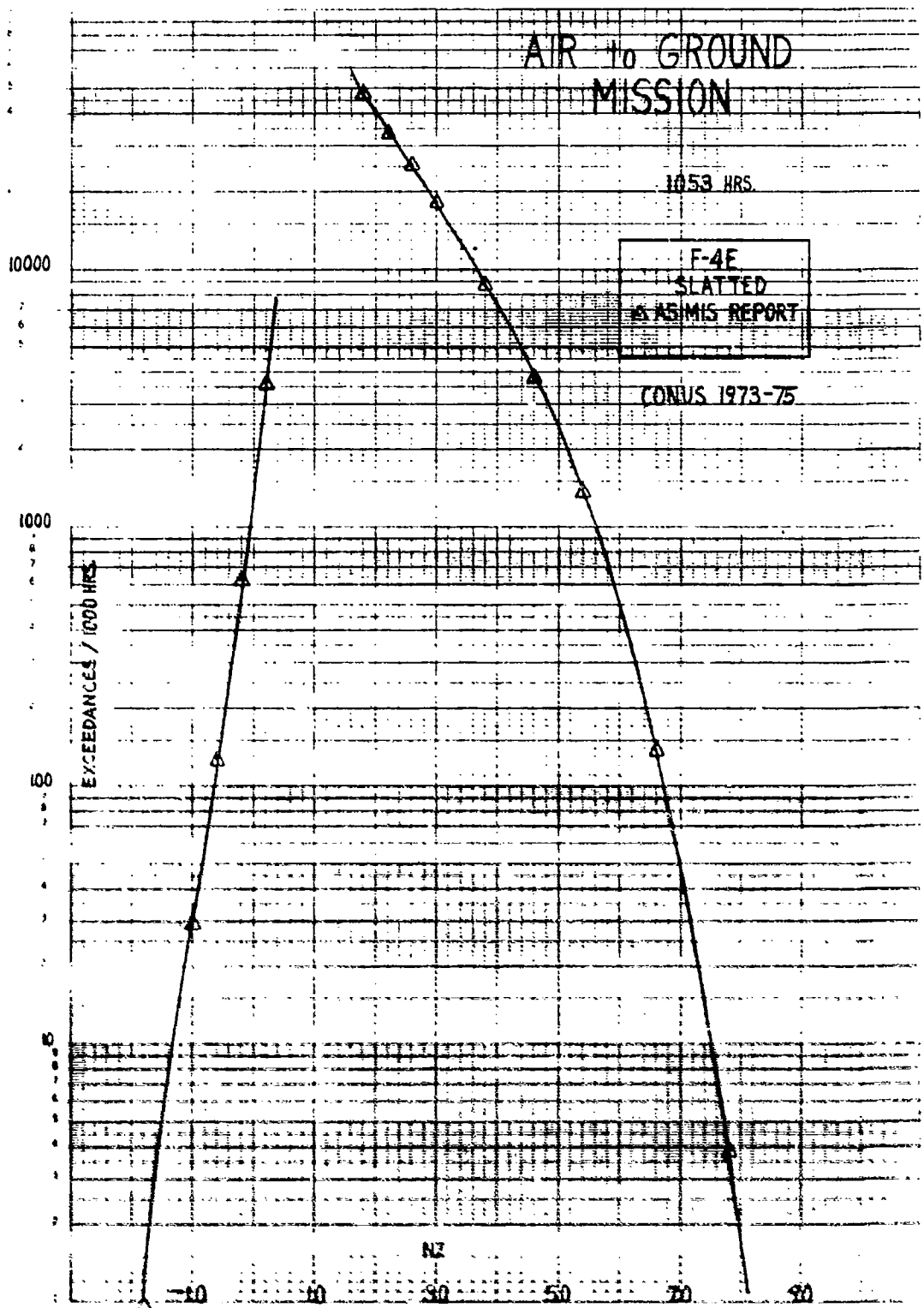
FIGURE 45

FIGURE 46

67
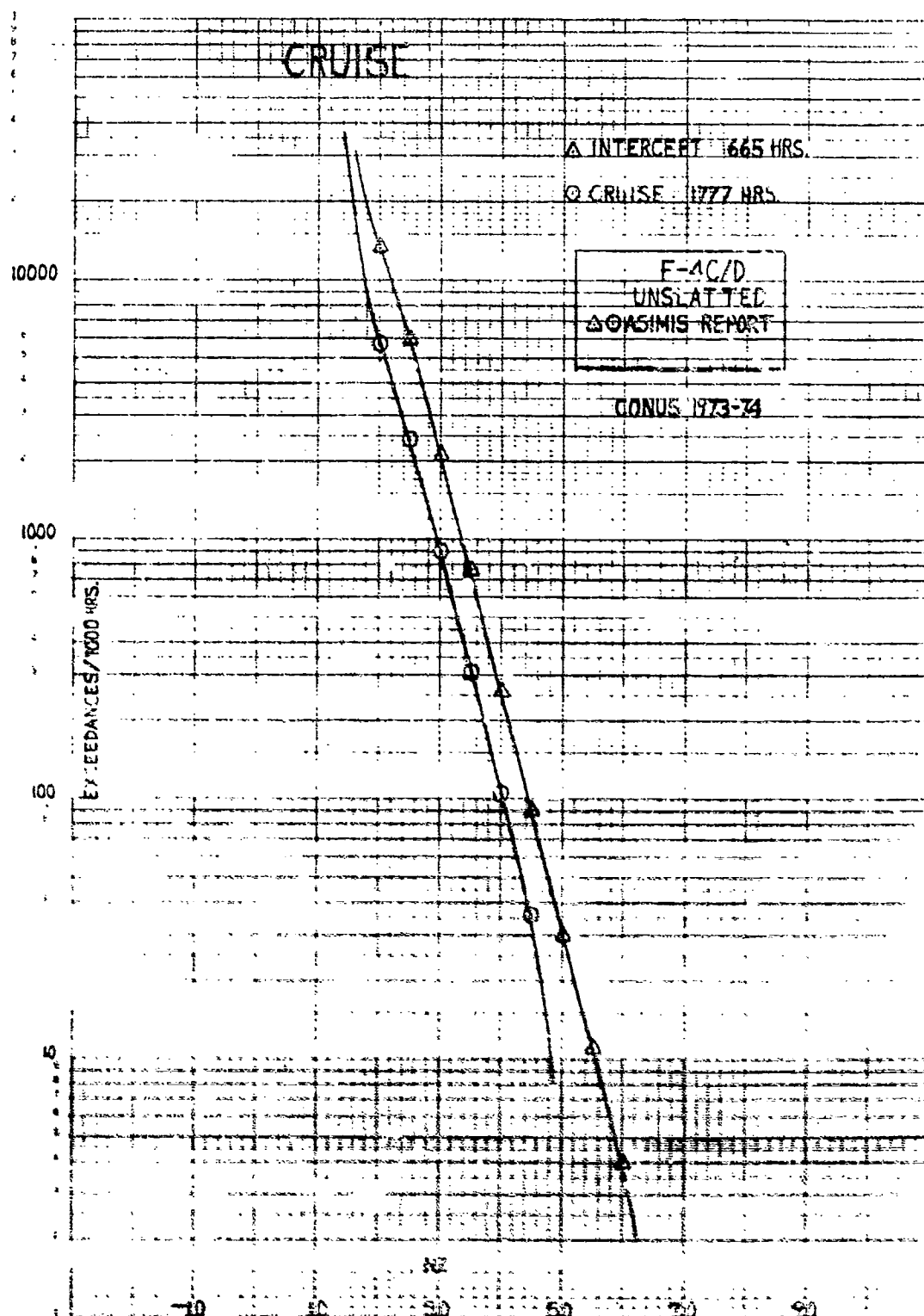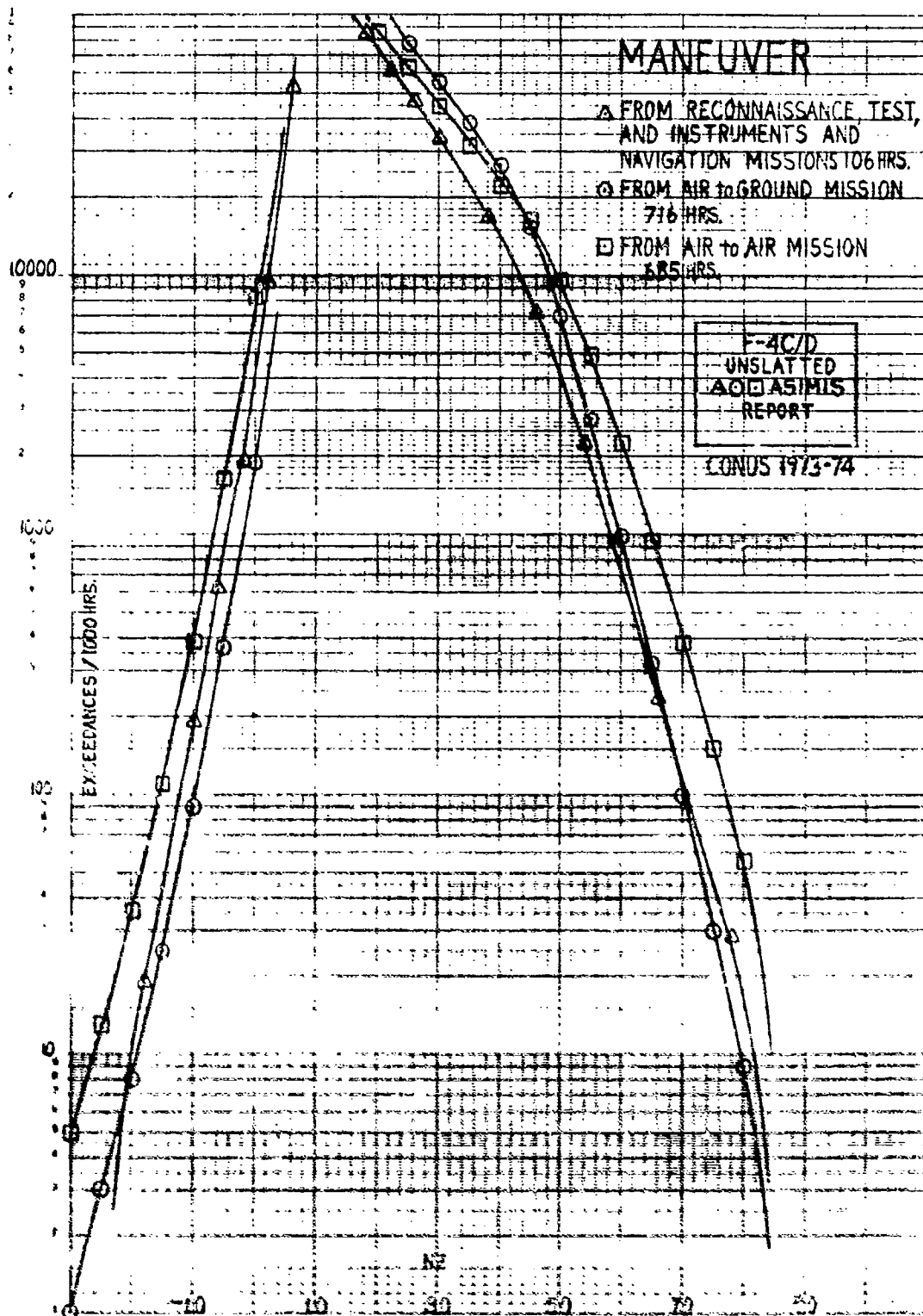
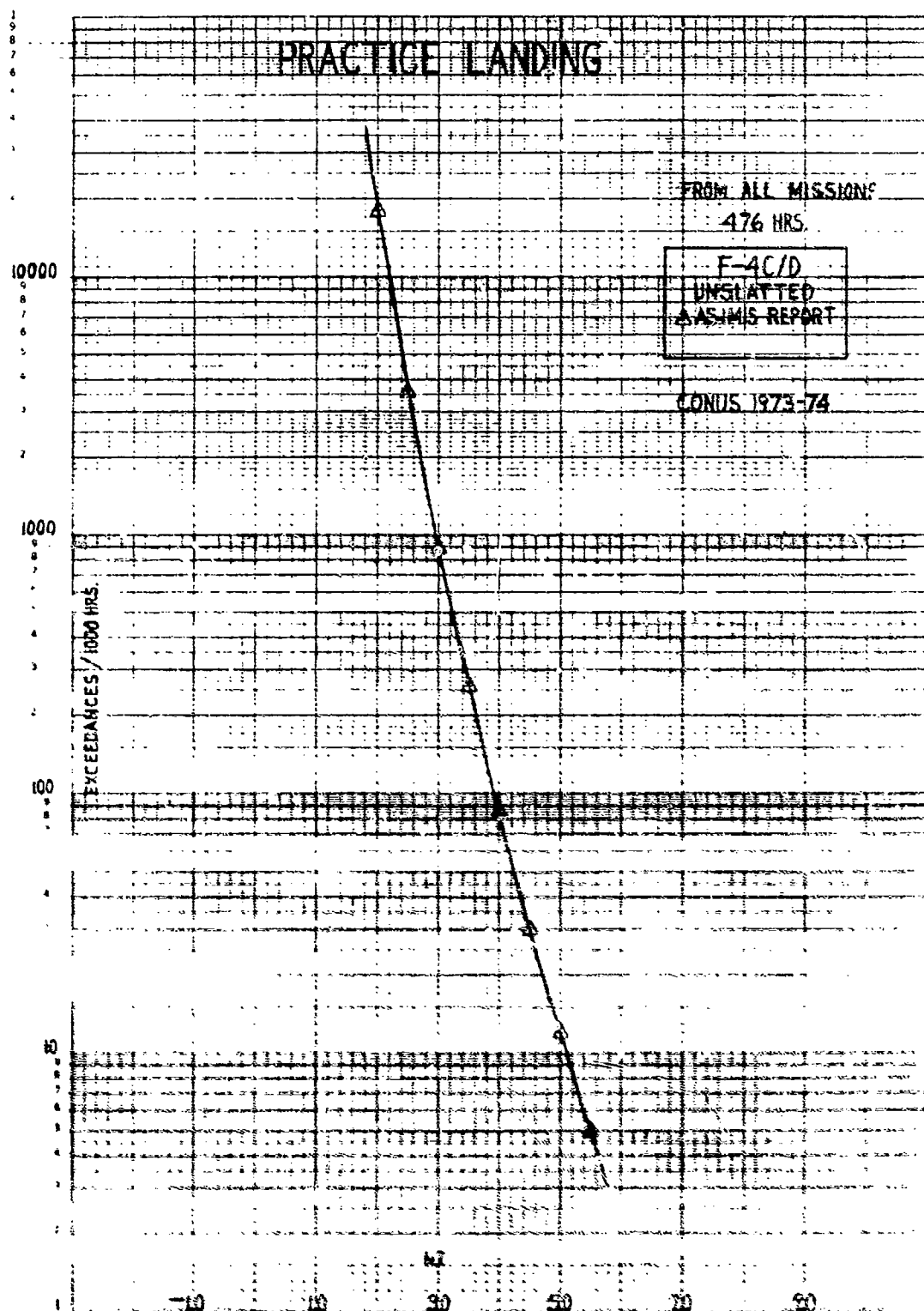FIGURE 47

FIGURE 48

69

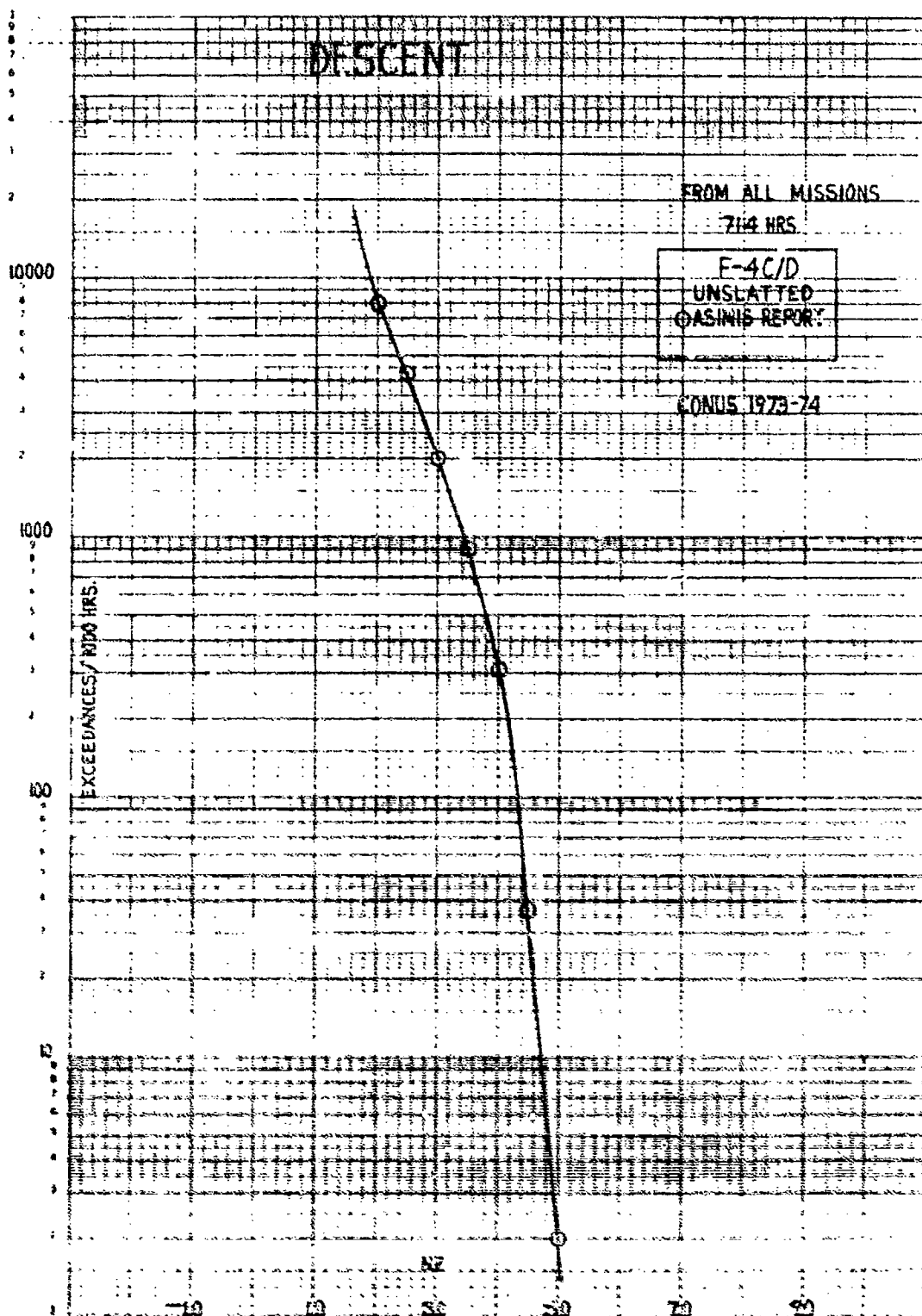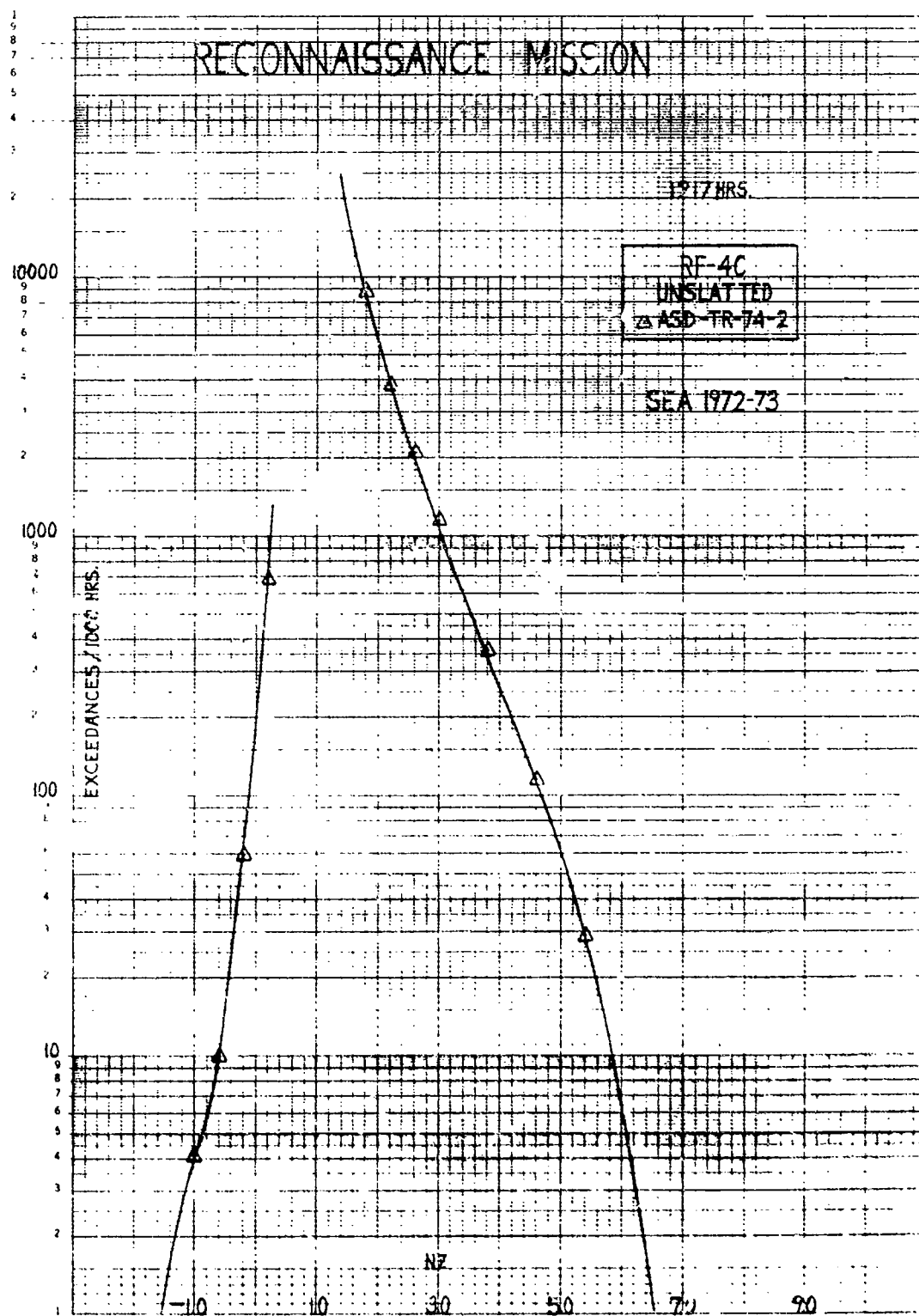FIGURE 49

70

FIGURE 50

71

FIGURE 51

TABLE 17

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

FIGHTER/ATTACK CLASS   MISSION DATA

NZ	TRANSITION	GROUND ATTACK	SURFACE ATTACK	SURFACE ATTACK TACTICS	TEST
9.0		1	1		
8.5		11	11		2
8.0	5	80	47	1	10
7.5	18	284	92	11	38
7.0	54	717	263	45	109
6.5	127	1428	615	159	256
6.0	267	2396	1156	407	571
5.5	535	3522	1905	875	1072
5.0	1003	4711	2845	1710	1728
4.5	1840	6198	4180	3024	2730
4.0	3371	8298	6341	5068	4431
3.5	5933	11335	9932	8425	7213
3.0	9337	15853	15578	13649	11120
2.5	13707	22136	23052	21072	16294
2.0	26780	39690	44268	41876	29873
0.0	33	32	17	132	33
-0.5	10			30	6
-1.0				5	2
HOURS:	509	364	471	535	425

HOURS REFERS TO AMOUNT OF RECORDED DATA

73

FIGURE 52

74

FIGURE 53

75

FIGURE 54

76

SURFACE ATTACK
TACTICS MISSION

535 HRS.

A-10
△ FAIRCHILD REPORT
SR160R0021

JUNE 1980
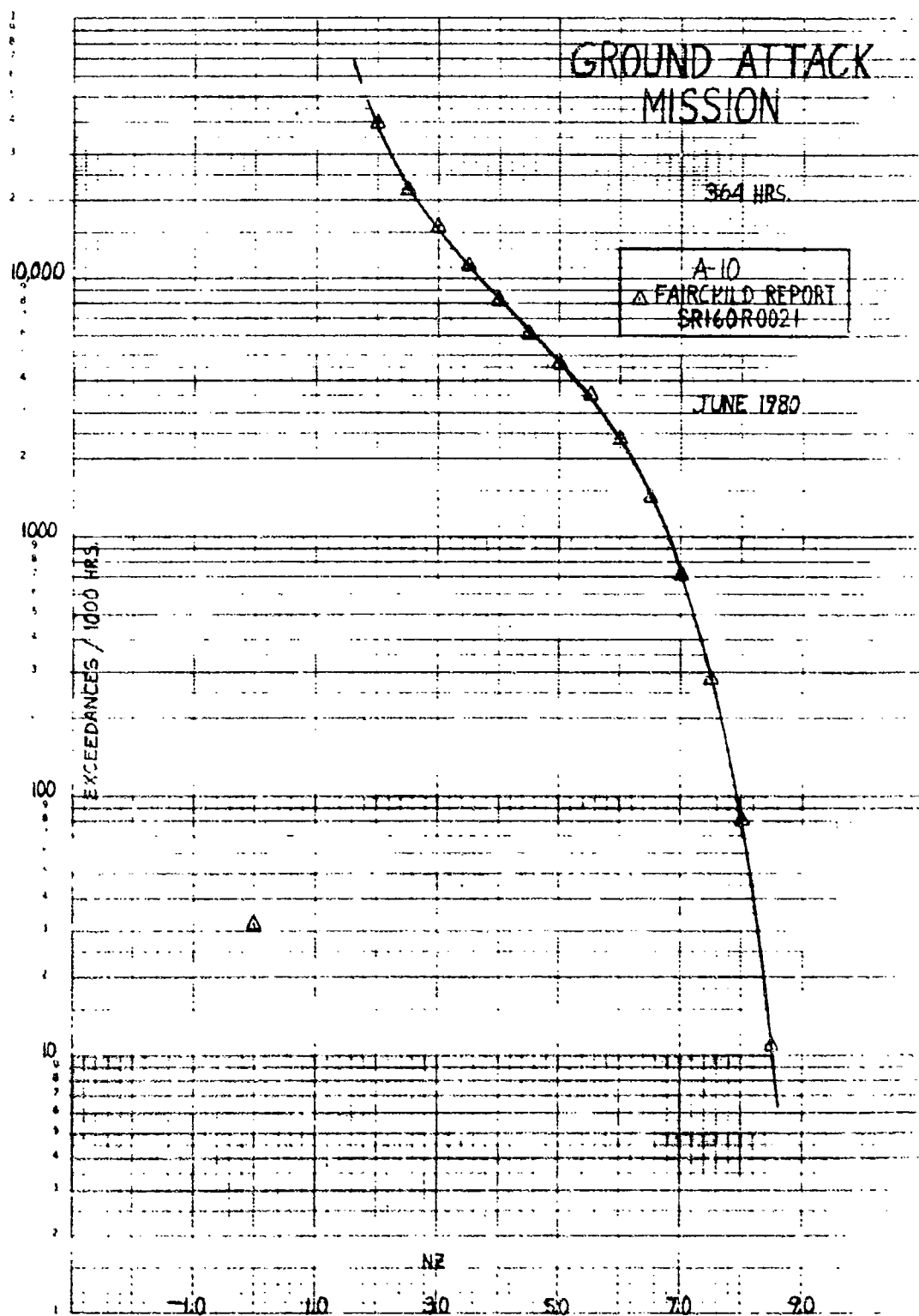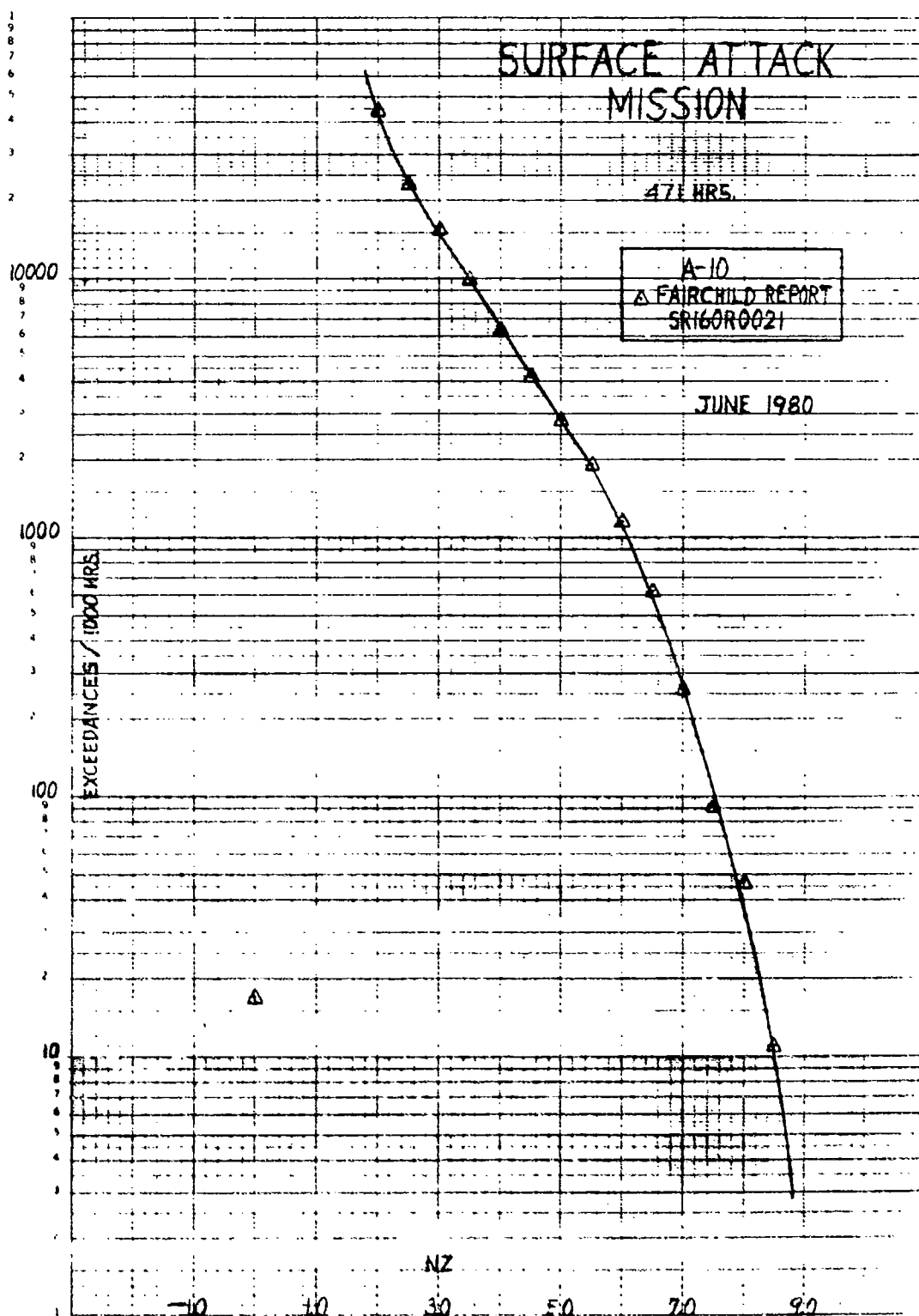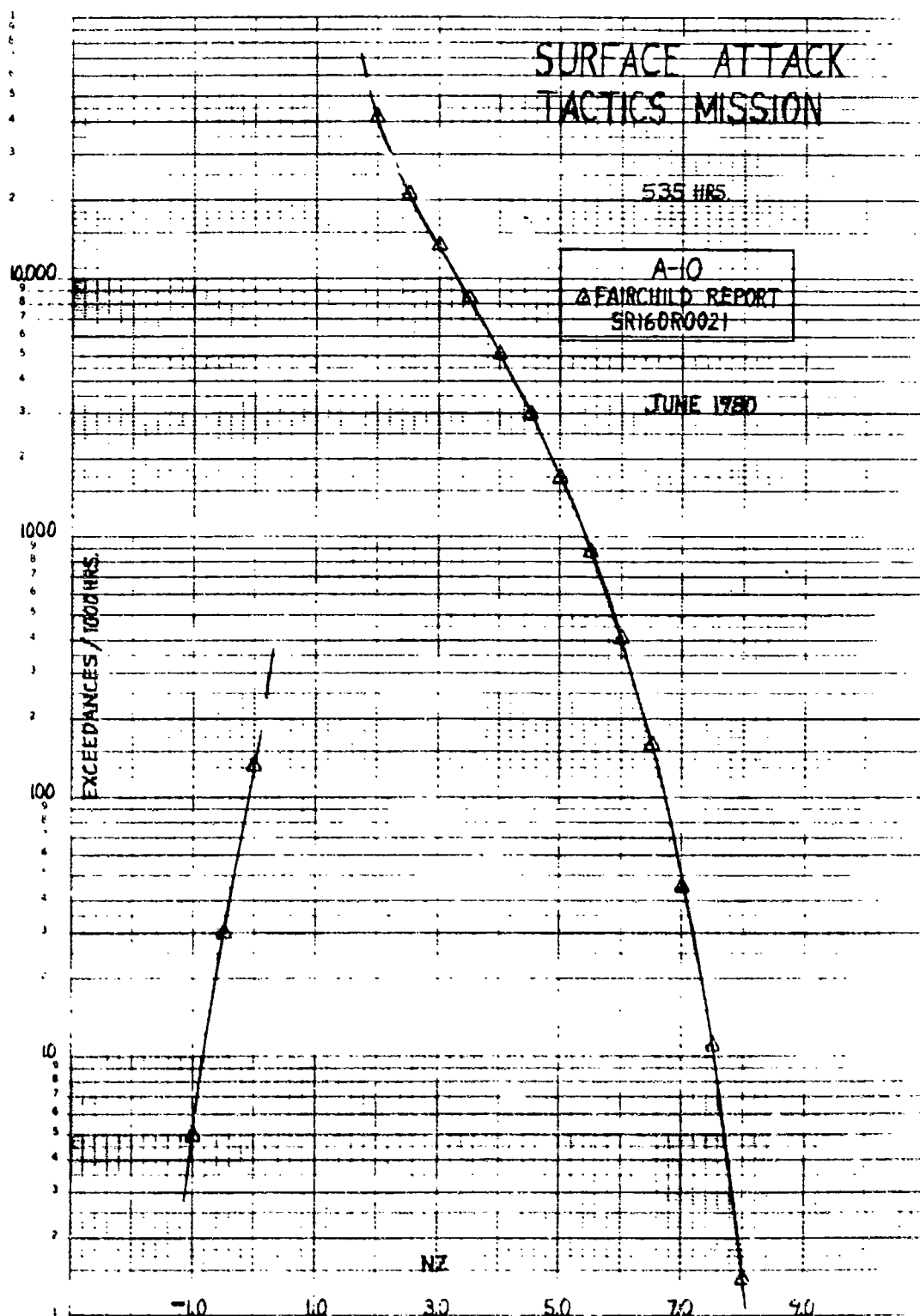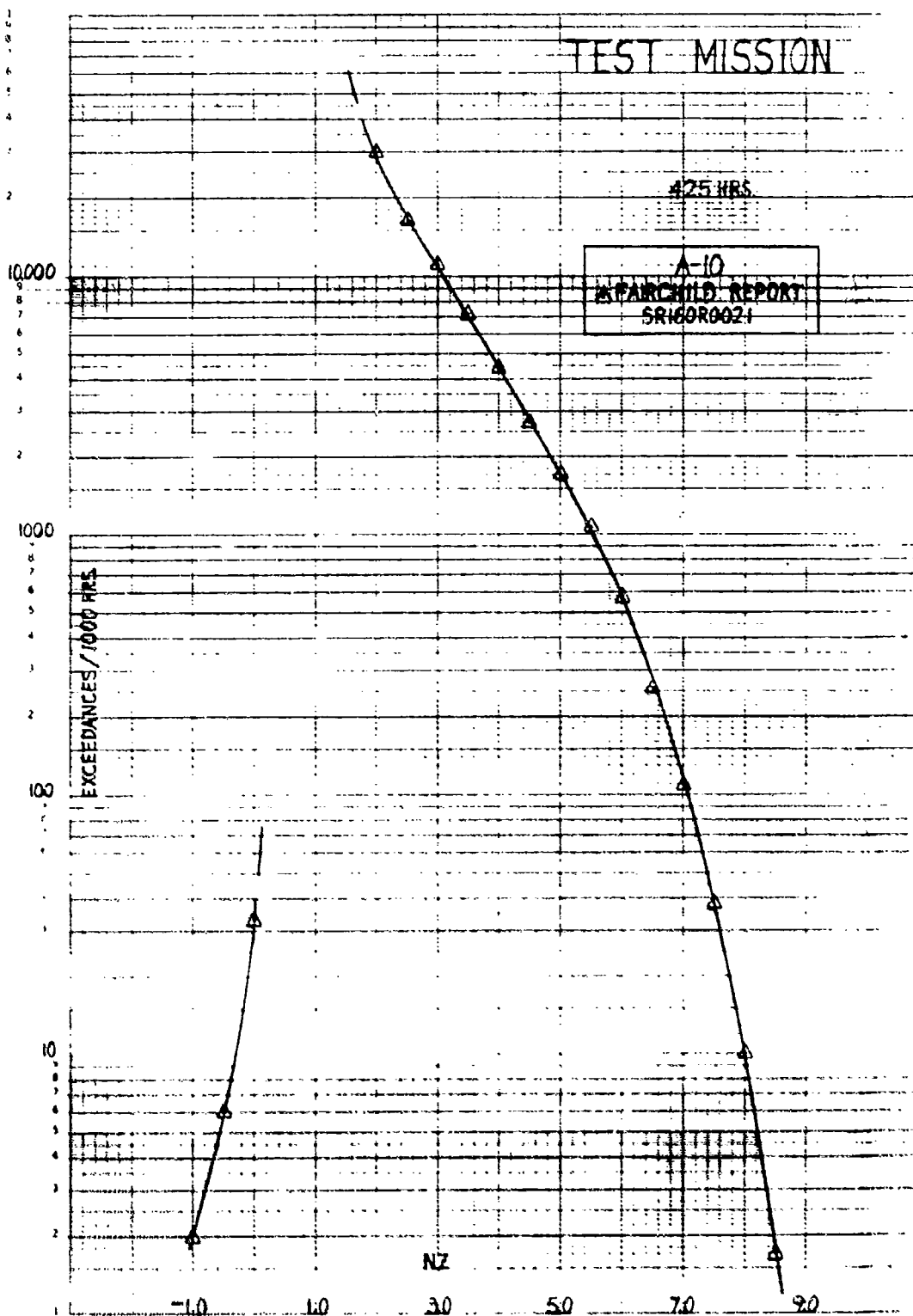
FIGURE 55

77

FIGURE 56

78
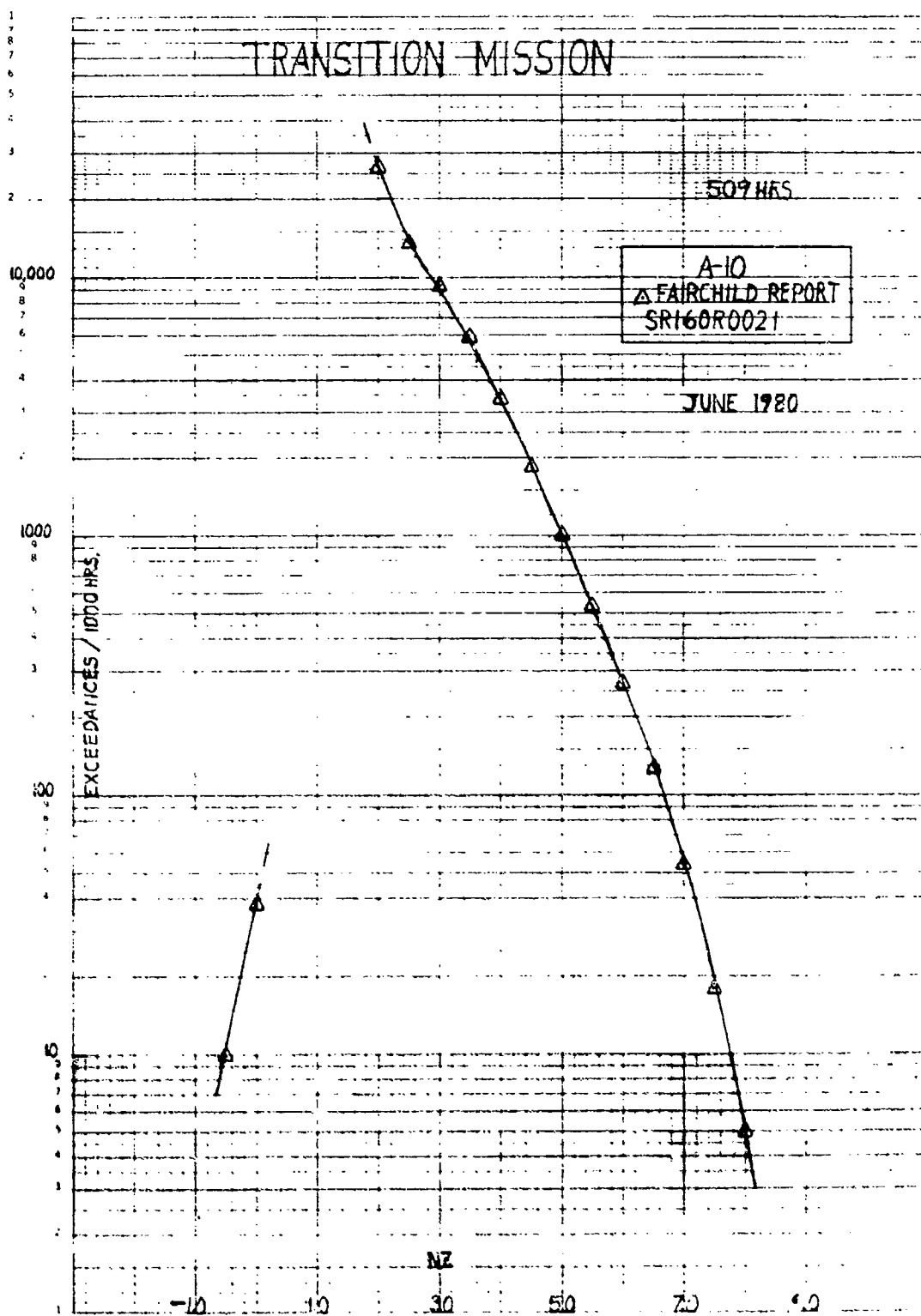
TABLE 18

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

FIGHTER CLASS   CONUS MISSION DATA

NZ	TRANSITION	INSTRUMENT/FERRY	AIR COMBAT MANEUVERS	AIR TO AIR	AIR TO GROUND
9.5				73	10.4
9.0	30.7	29.6	26.8	109	20.9
8.5	245	59	187	292	63
8.0	521	89	669	438	125
7.5	966	207	1620	876	417
7.0	1641	355	2396	1423	1178
6.5	2454	444	3628	2299	1814
6.0	3635	562	5489	3613	3233
5.5	5015	888	7523	4964	5537
5.0	7362	1154	9732	6642	8571
4.5	10092	1805	13173	8431	12753
4.0	12945	2456	17697	11277	17602
3.5	17439	3254	22129	15146	22878
3.0	22347	4645	28220	19927	29666
2.5	23466	5917	34913	25620	36642
2.0		6391	36894	27847	38373
0.0	337	89	1205	365	271
-0.5	184	29.6	495	73	83
-1.0	61		94	36.5	20.9
-1.5	46		13.4		10.4
-2.0	15.3				
HOURS:	65	34	75	27	96

HOURS REFERS TO AMOUNT OF RECORDED DATA

79

FIGURE 57

INSTRUMENT/FERRY MISSION

34 HRS.

F-16
△ GENERAL DYNAMICS
16PRI535-3

JULY 1981

EXCEEDANCES / 1000 HRS.

NZ

FIGURE 58

81

AIR COMBAT MANEUVERS MISSION

75 HRS.

F-16
△ GENERAL DYNAMICS
16PRI535-3

JULY 1981

EXCEEDANCES / 1000 HRS.

NZ
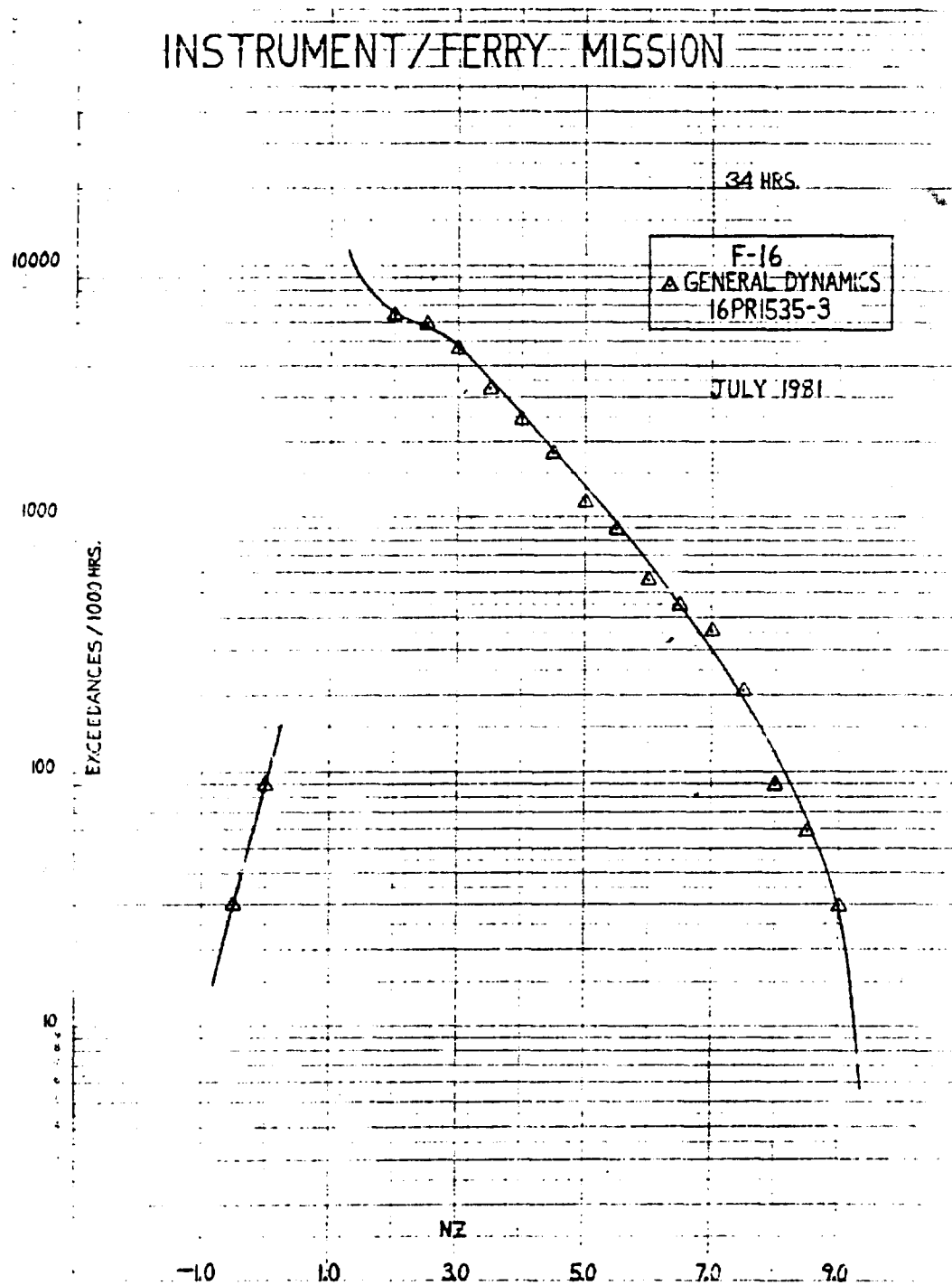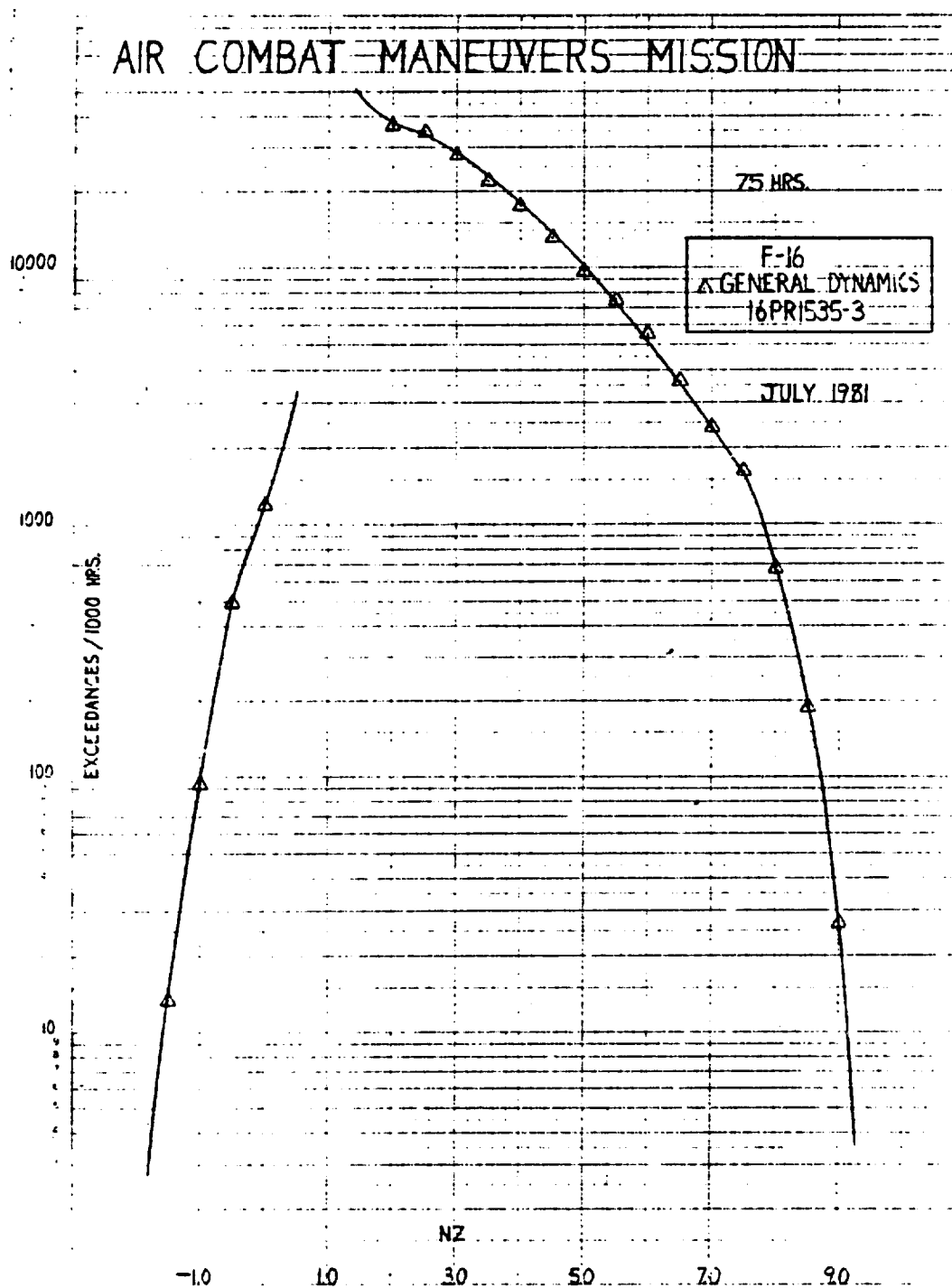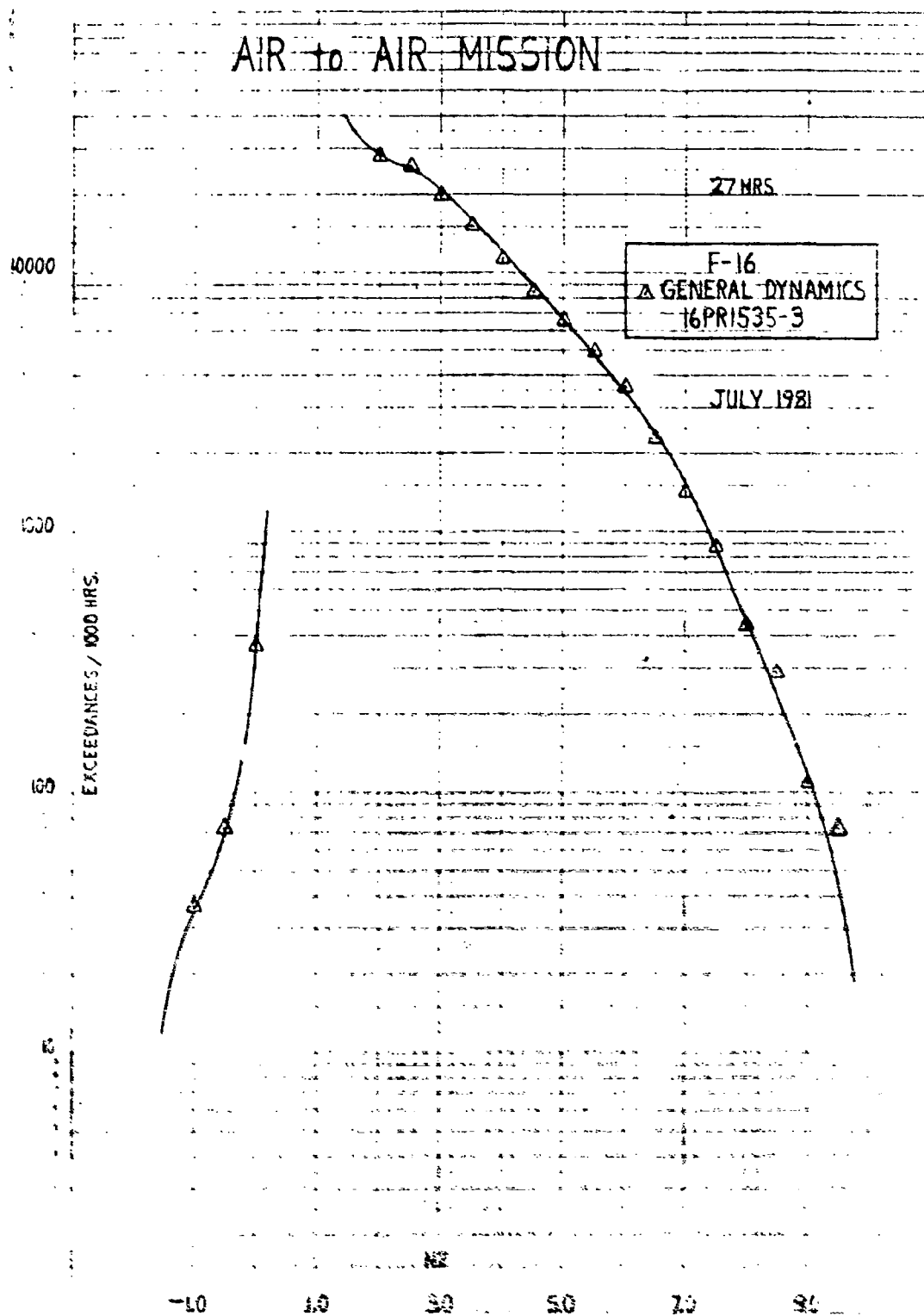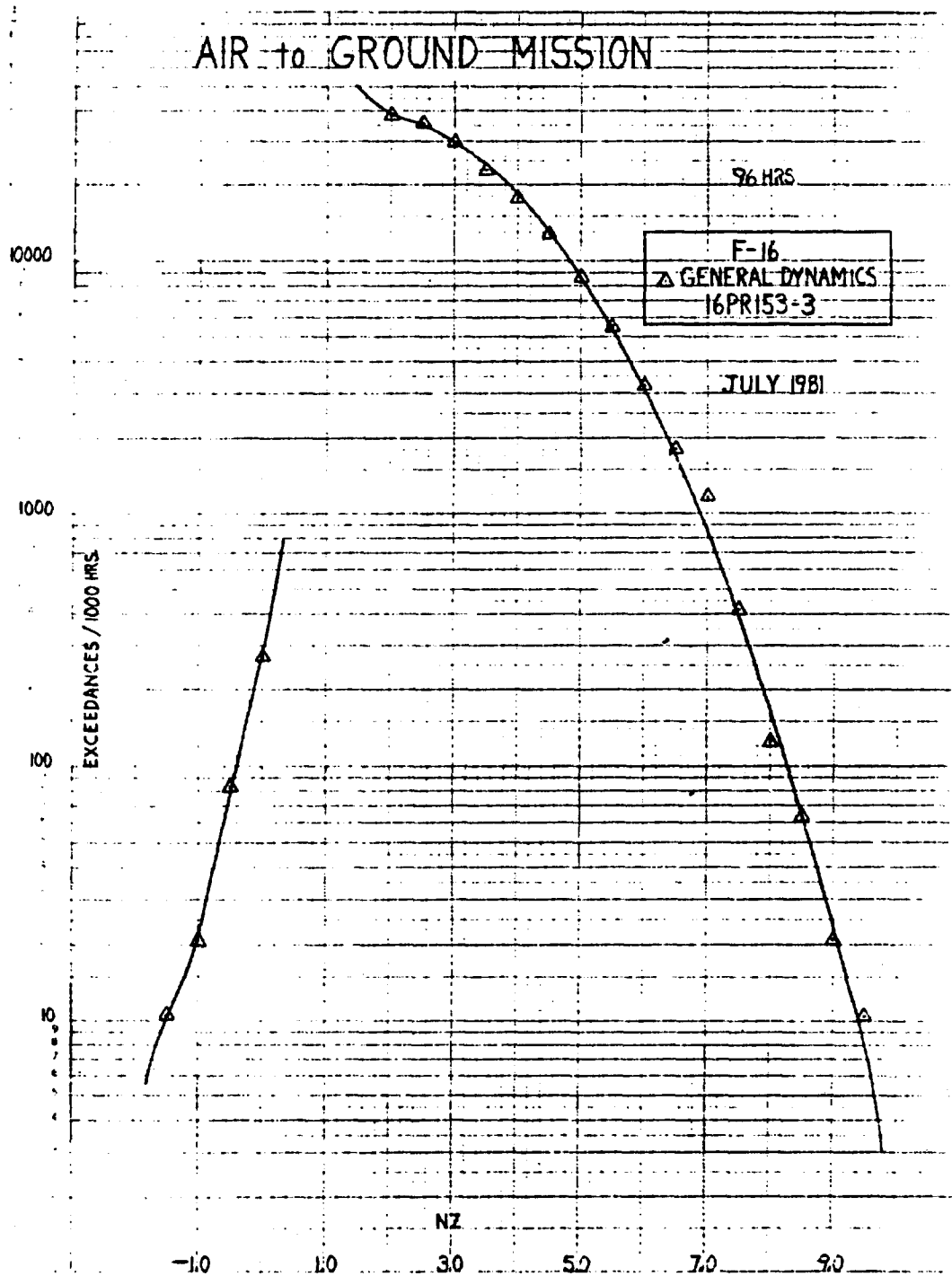
FIGURE 59

82
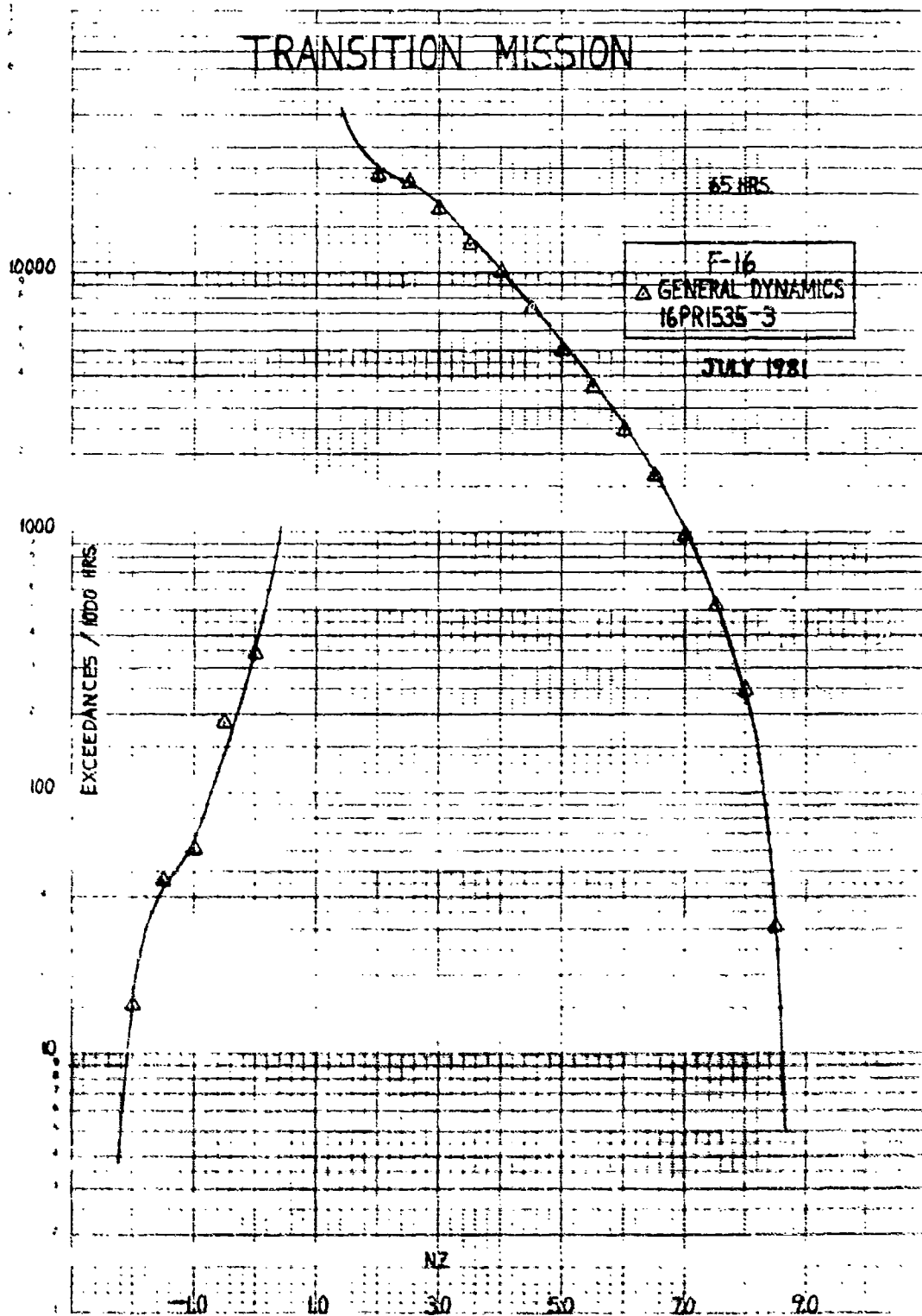
FIGURE 60

FIGURE 61

84

TABLE 19

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

MISSION DATA

NZ	BASIC	ADVANCED	INSTRUMENTS & NAVIGATION	FORMATION	TEST & ADMINISTRATIVE
6.0					
5.5	4	49	3		21
5.0	19	154	9	5	43
4.5	46	529	28	65	117
4.0	164	1672	102	253	532
3.5	474	4514	350	694	1342
3.0	1368	8802	967	1834	3035
2.5	5682	15120	2940	5390	6113
2.0	23080	29521	8918	13018	15208
0.0	279	1817	206	242	596
-0.5	38	576	12	43	197
-1.0	19	226	2	21	75
-1.5	4	75		5	16
-2.0		22			
HOURS:	262	809	577	186	188

TRAINER CLASS
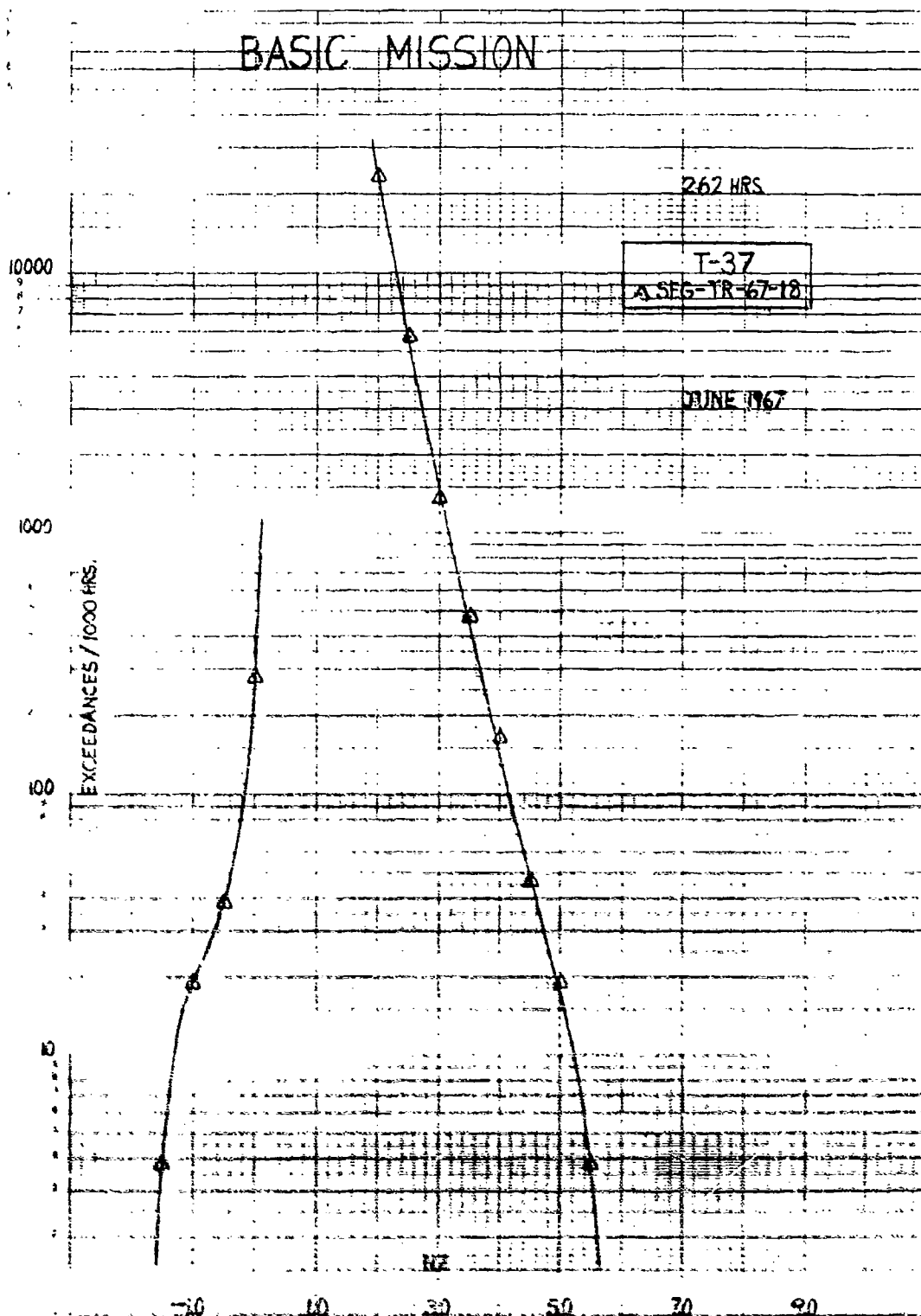
REFERENCE: T-37, (SEGMA-R-67-18)   HOURS REFERS TO AMOUNT OF RECORDED DATA

85

FIGURE 62

86

FIGURE 63

87

FIGURE 64

FIGURE 65

89

TEST and ADMINISTRATIVE
MISSION

188 HRS

T-37
△ SEG-TR-67-18

JUNE 1967

EXCEEDANCES/1000 HRS.

NZ

FIGURE 66

90
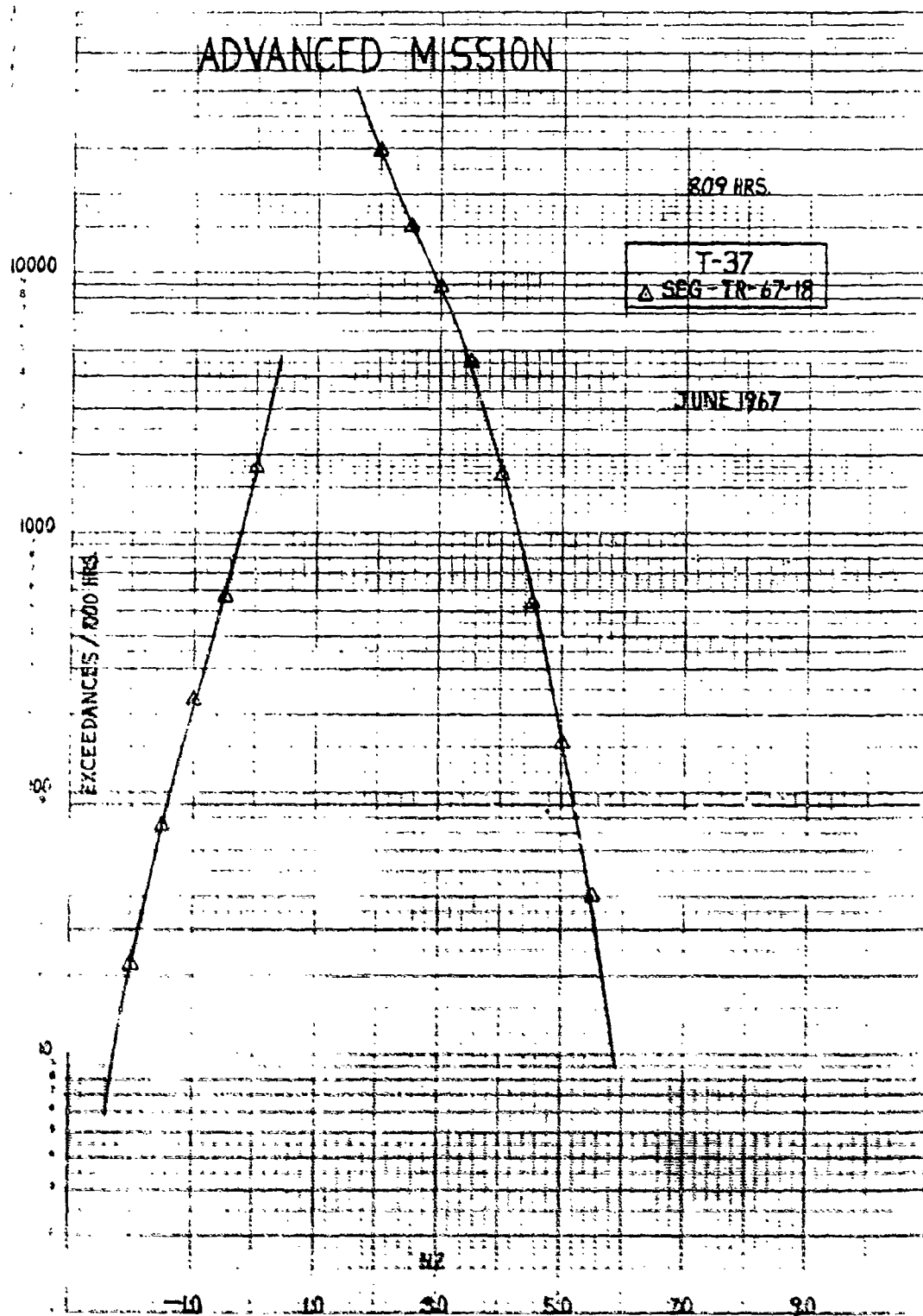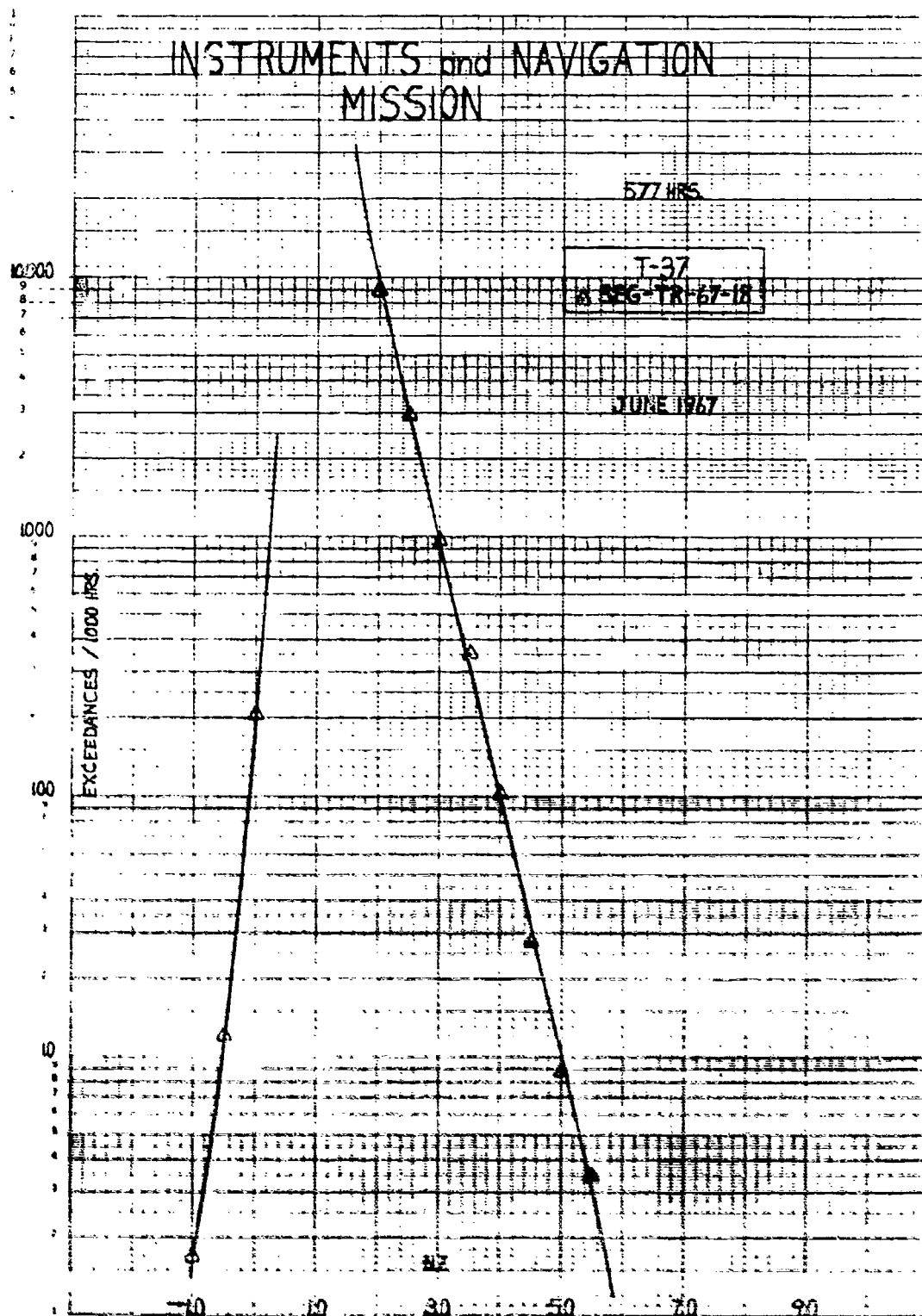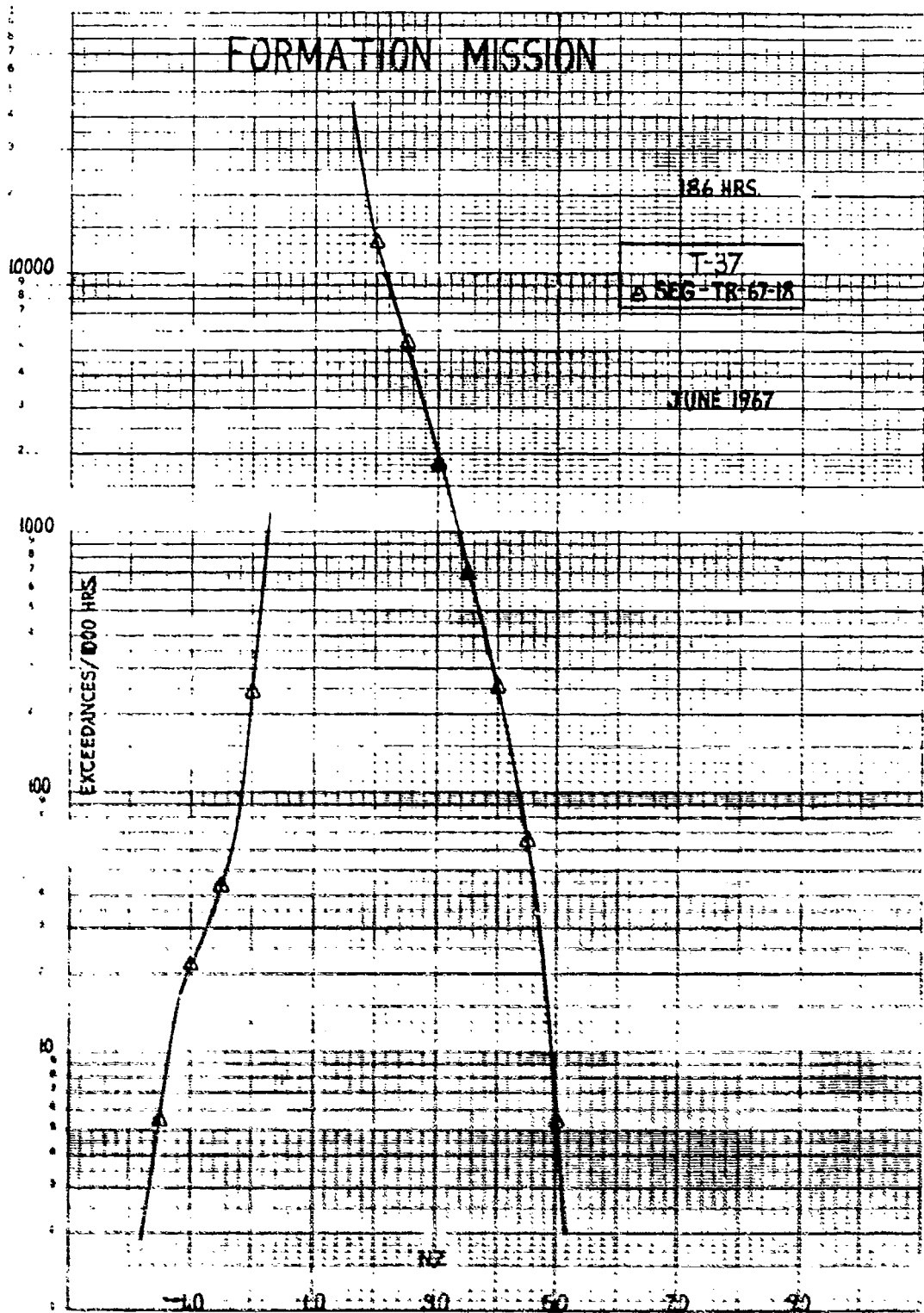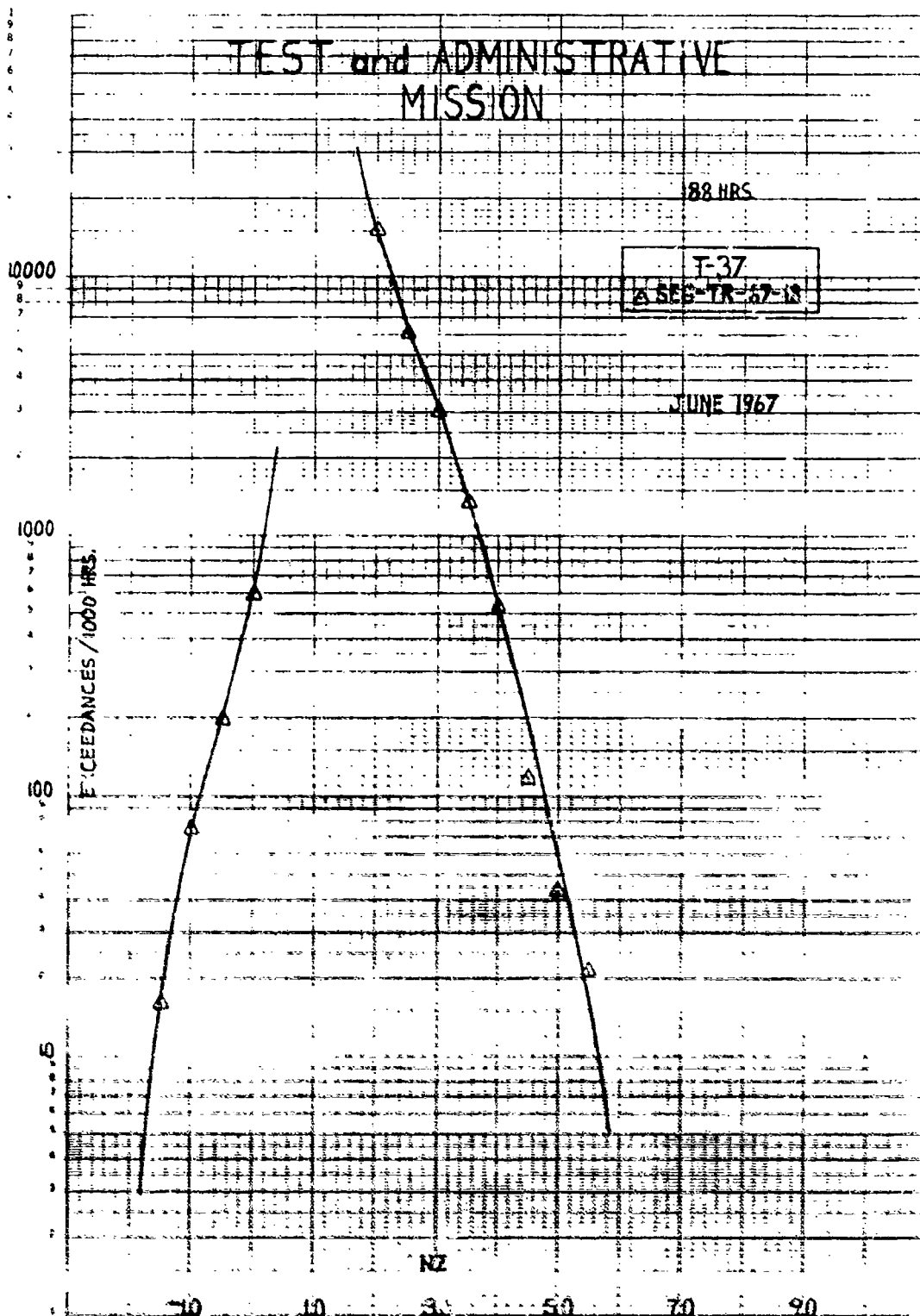
TABLE 20

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

TRAINER CLASS

MISSION DATA

NZ	TRAINING	FORMATION	NAVIGATION & GENERAL	ADMINISTRATIVE
8.0				
7.5				
7.0	3			
6.5	13	6	2	
6.0	52	29	5	
5.5	202	135	17	58
5.0	720	435	56	250
4.5	1630	1030	173	690
4.0	2960	1760	365	1460
3.5	4400	3150	670	2600
3.0	7075	4962	1367	4076
2.5	12500	9200	3600	7100
2.0	24700	19600	9300	13500
0.0	235	50	110	1000
-0.5	33	11	9	720
-1.0	10	4	3	446
-1.5	3	1		10
-2.0				
-2.5				
HOURS:	1933	265	1598	108

HOURS REFERS TO AMOUNT OF RECORDED DATA

REFERENCE: T-38, (ASD-TR-72-54)

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TABLE 21

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

TRAINER CLASS

TRAINING MISSION PHASE DATA

NZ	ASCENT	CRUISE	MANEUVER	DESCENT	PRACTICE LANDING
8.0			1		
7.5			5		
7.0			19		
6.5			76		
6.0			285		
5.5			1110	2	
5.0			3500	7	5
4.5			8800	22	17
4.0		12	16300	71	50
3.5	7	90	25500	240	260
3.0	58	554	35570	830	1628
2.5	400	3700	46500	2900	8900
2.0	2150	13200	61500	12400	49000
0.0	42	81	670	84	160
-0.5	7	11	153	12	4
-1.0	1	3	52	1	
-1.5			15		
-2.0			3		
-2.5					
HOURS:	174	780	345	278	355

REFERENCE: T-38, (ASD-TR-72-54)

HOURS REFERS TO AMOUNT OF RECORDED DATA

TABLE 22

MANEUVER NZ EXCEEDANCES PER 1000 HOURS

TRAINER CLASS   NAVIGATION AND GENERAL MISSION PHASE DATA

NZ	ASCENT	CRUISE	MANEUVER	DESCENT	PRACTICE LANDING
8.0					
7.5			1		
7.0			13		
6.5			57		
6.0		1	177		
5.5		3	570		
5.0		5	1840	3	
4.5		8	5700	13	
4.0	2	17	12200	35	22
3.5	19	72	22500	106	265
3.0	79	331	35385	444	1645
2.5	320	1900	48500	2100	9600
2.0	1700	10400	64000	10300	31500
0.0	80	92	710	74	93
-0.5	2	7	140	1	1
-1.0		2	44		
-1.5					
-2.0					
-2.5					
HOURS:	164	1048	46	288	53

HOURS REFERS TO AMOUNT OF RECORDED DATA
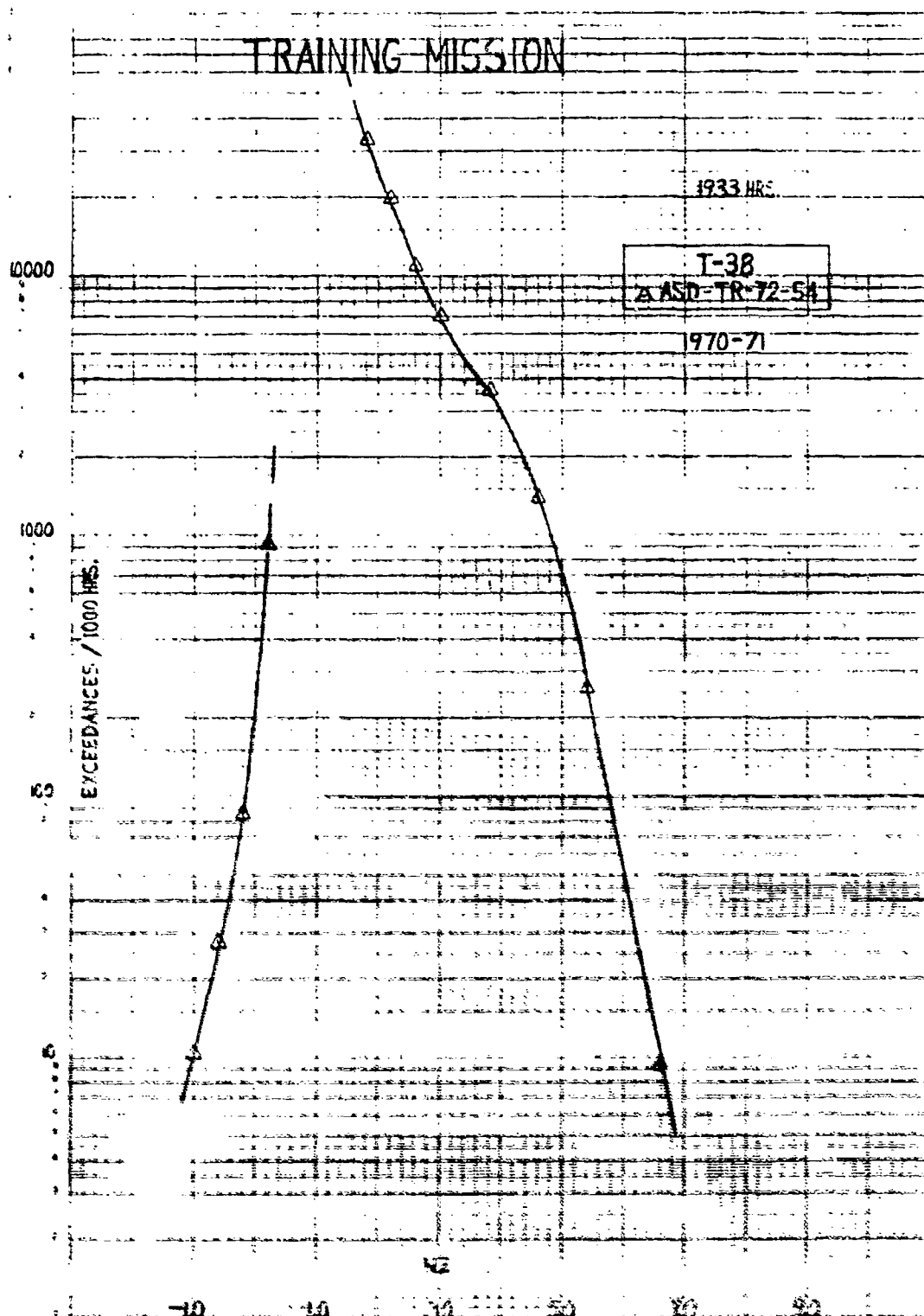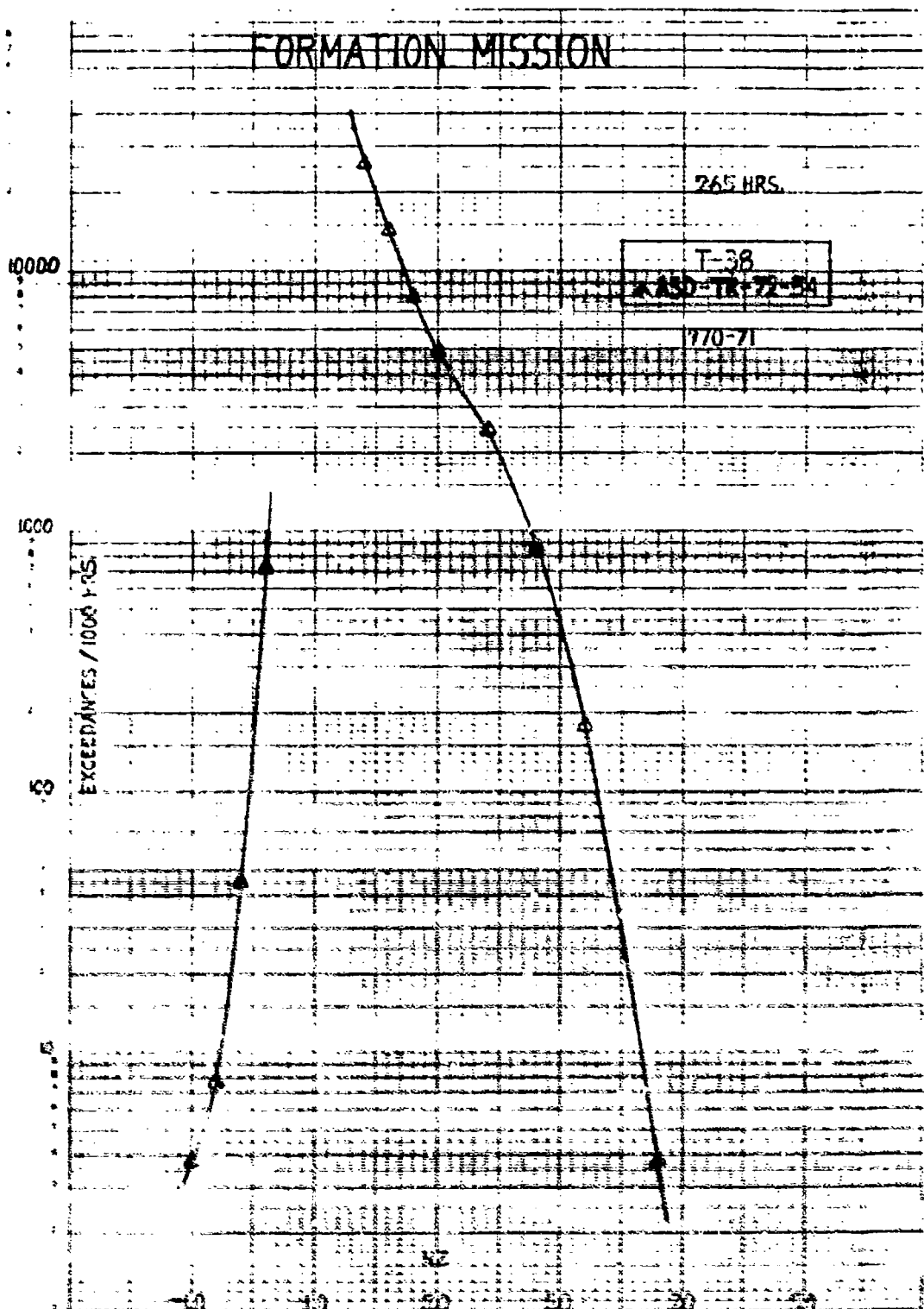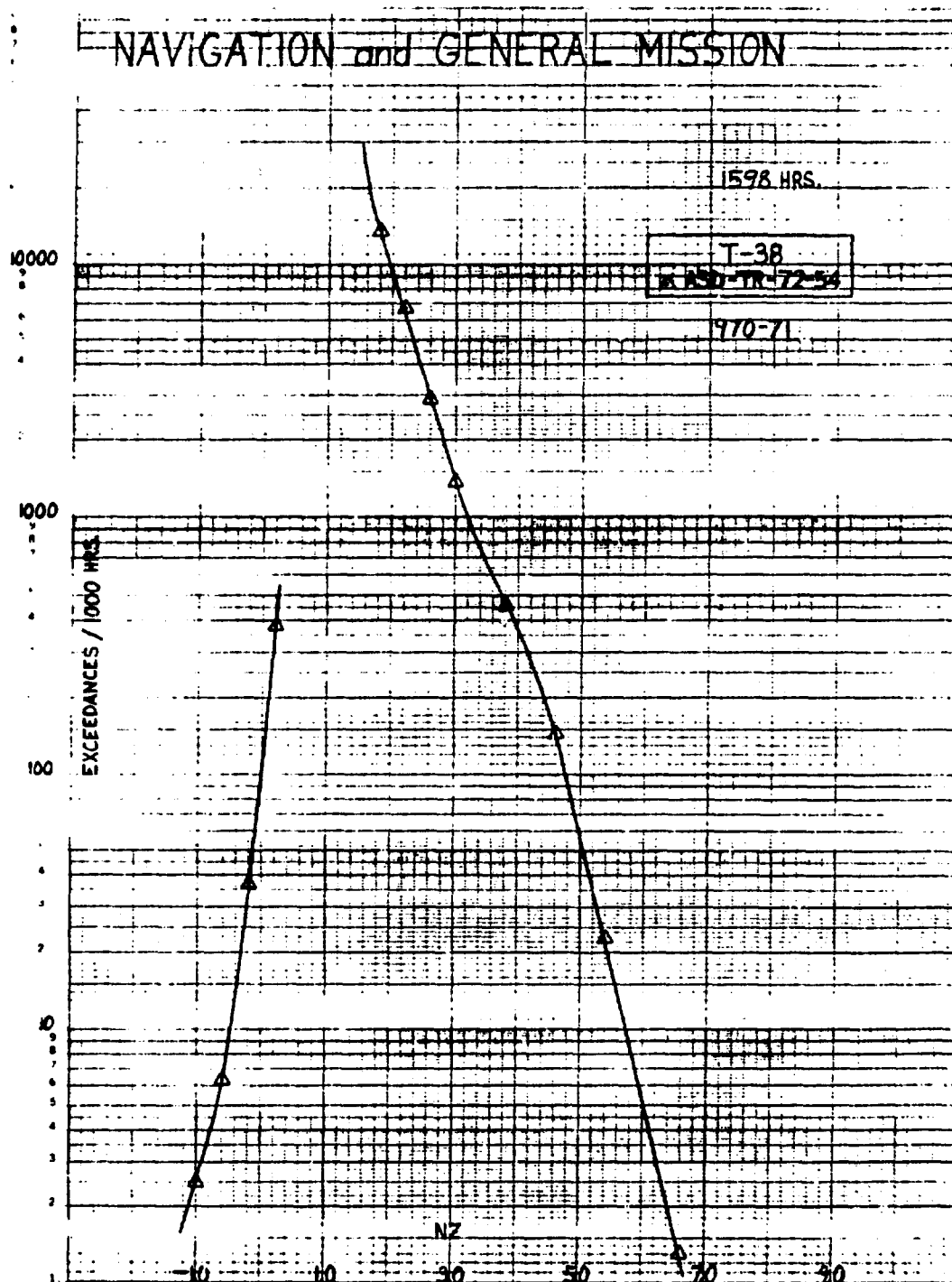
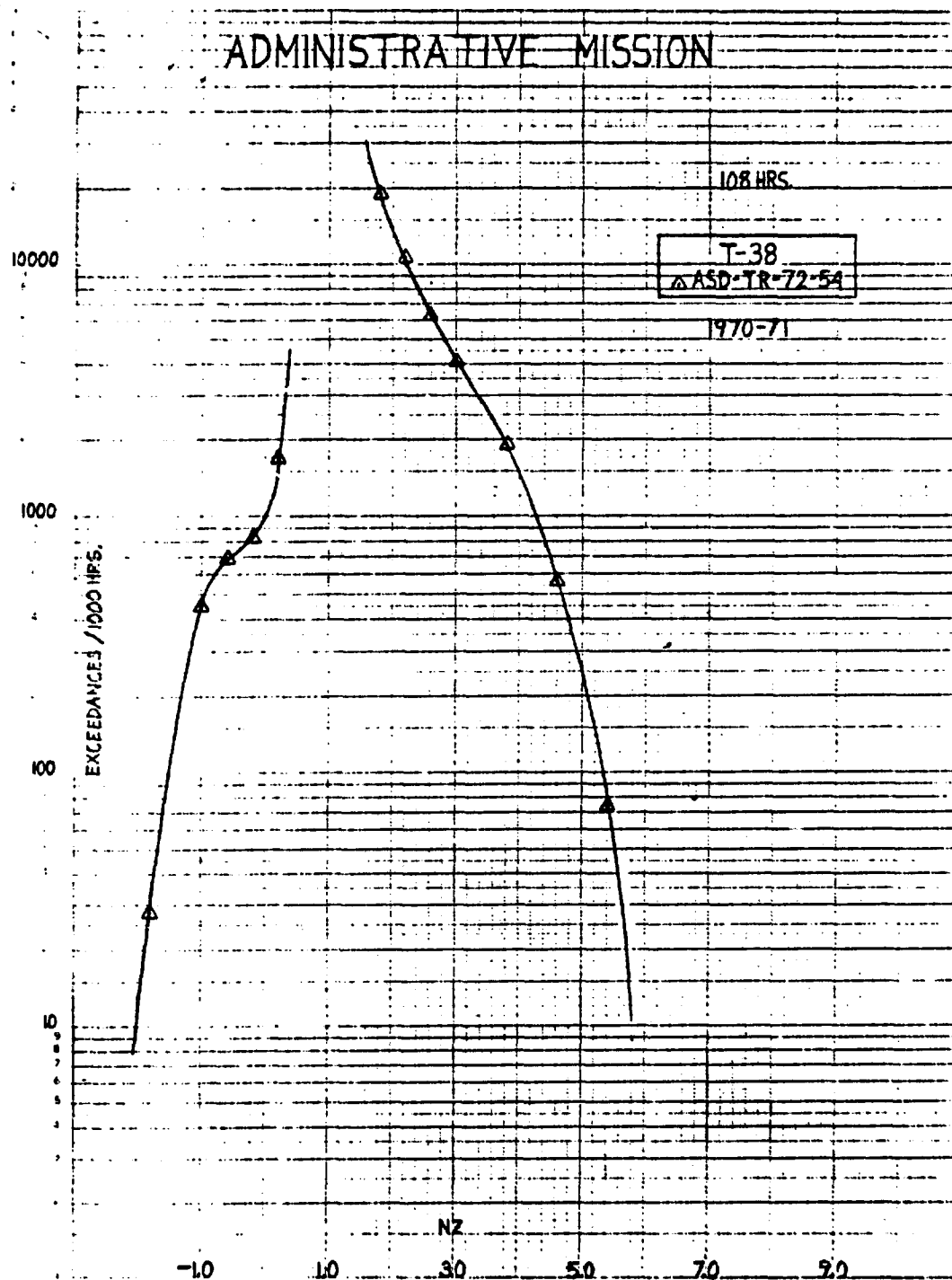REFERENCE: T-38, (ASD-TR-72-54)

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FIGURE 67

94

FIGURE 68

95

FIGURE 69

96

FIGURE 70

97

FIGURE 71

98

CRUISE

FROM TRAINING MISSION

780 HRS

T-38
△ ASD-TR-72-54

1970-71

FIGURE 72

99

FIGURE 73

100

FIGURE 74

101

FIGURE 75

FIGURE 76

103

FIGURE 77

104

MANEUVER

FROM NAVIGATION
AND GENERAL MISSION

46 HRS
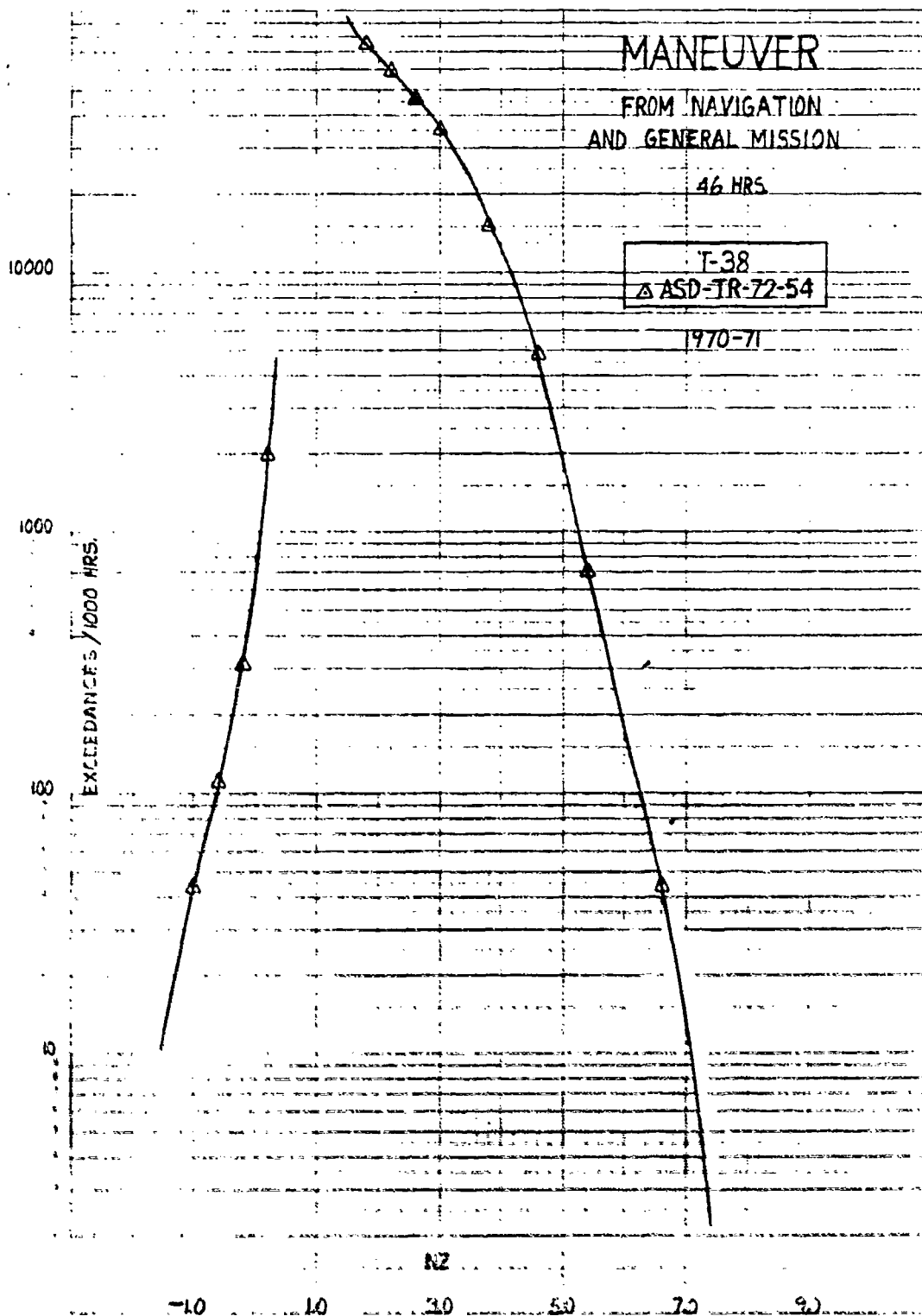
T-38
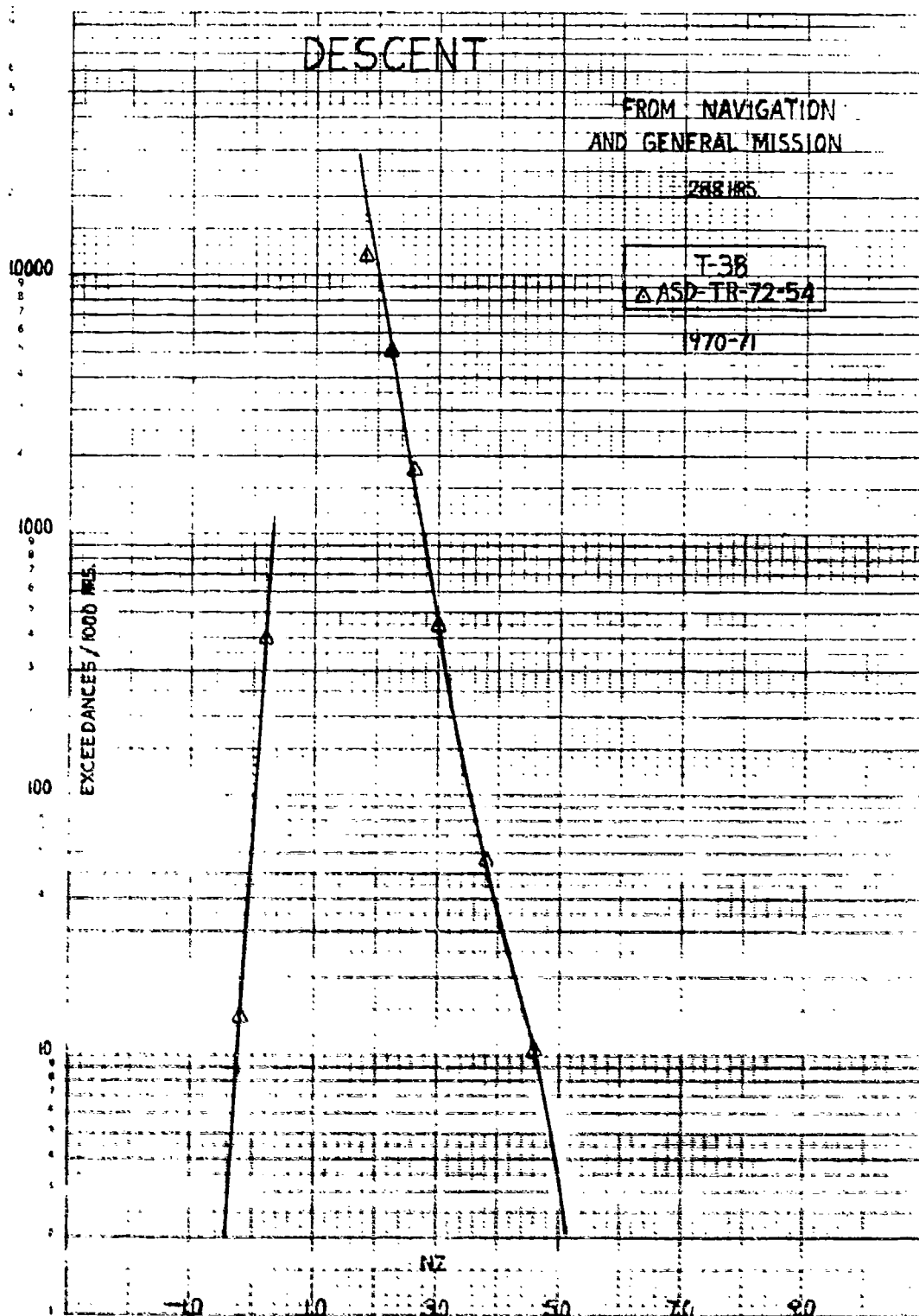△ ASD-TR-72-54
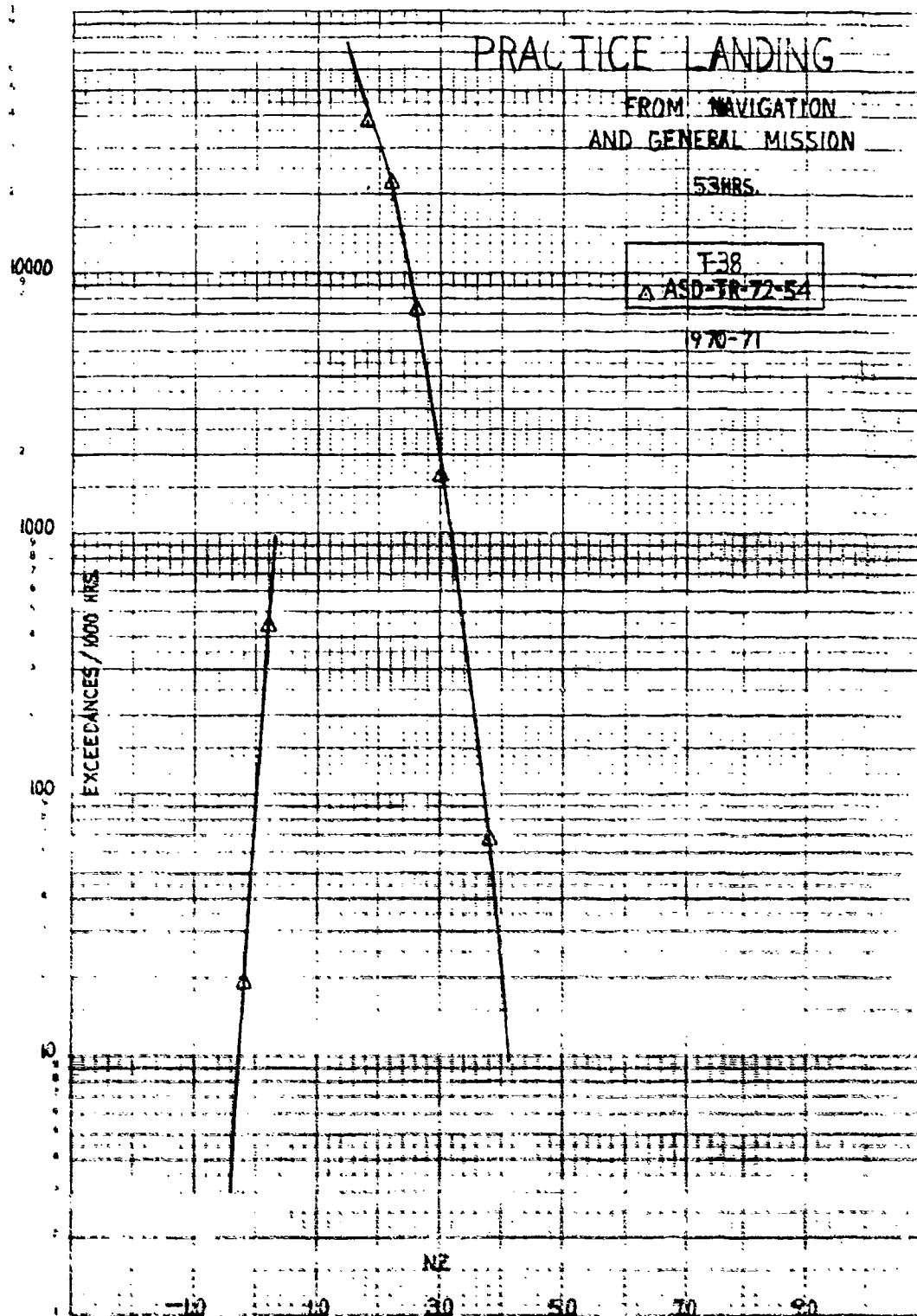
1970-71

FIGURE 78

105

FIGURE 79

106

FIGURE 80

107
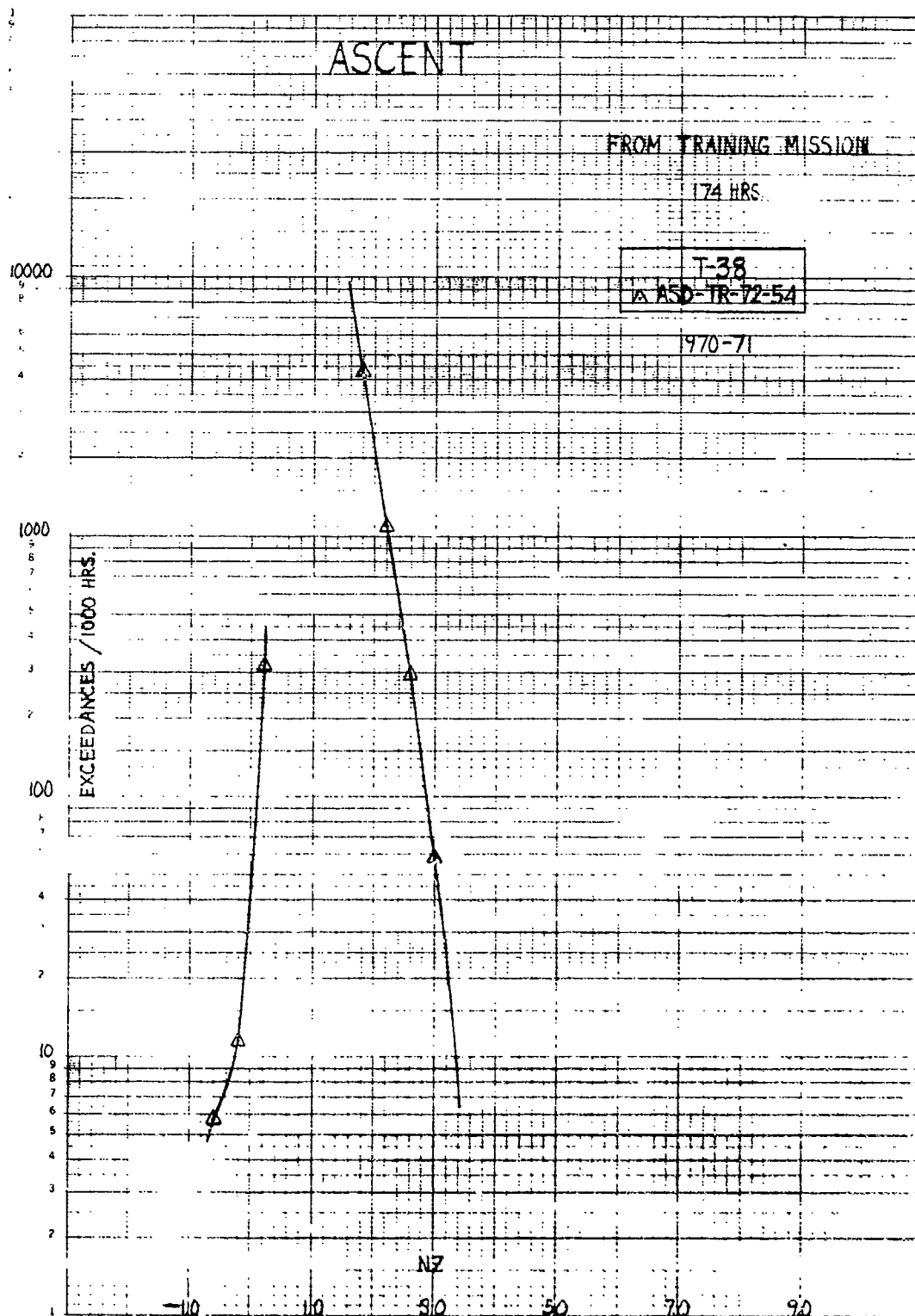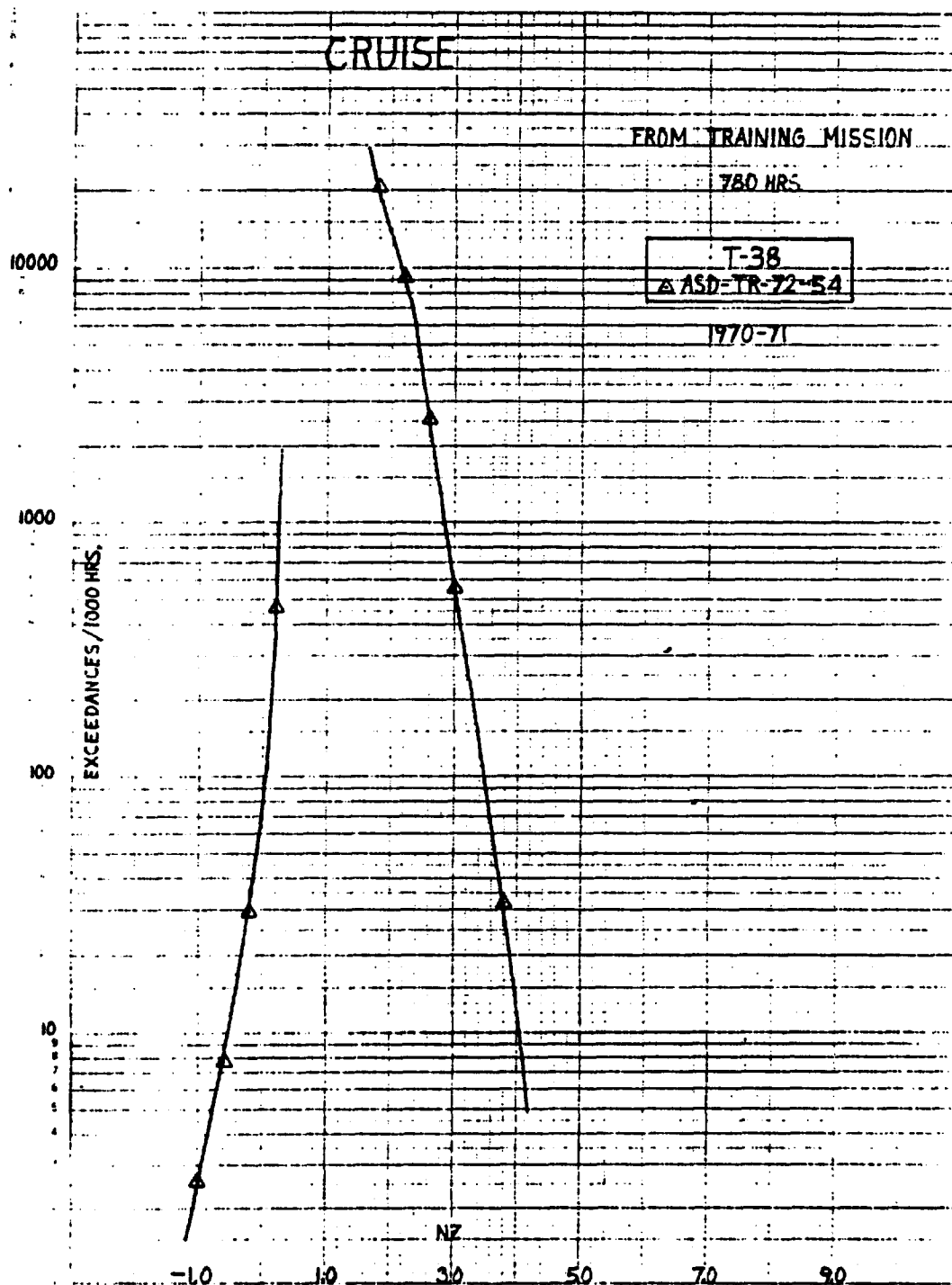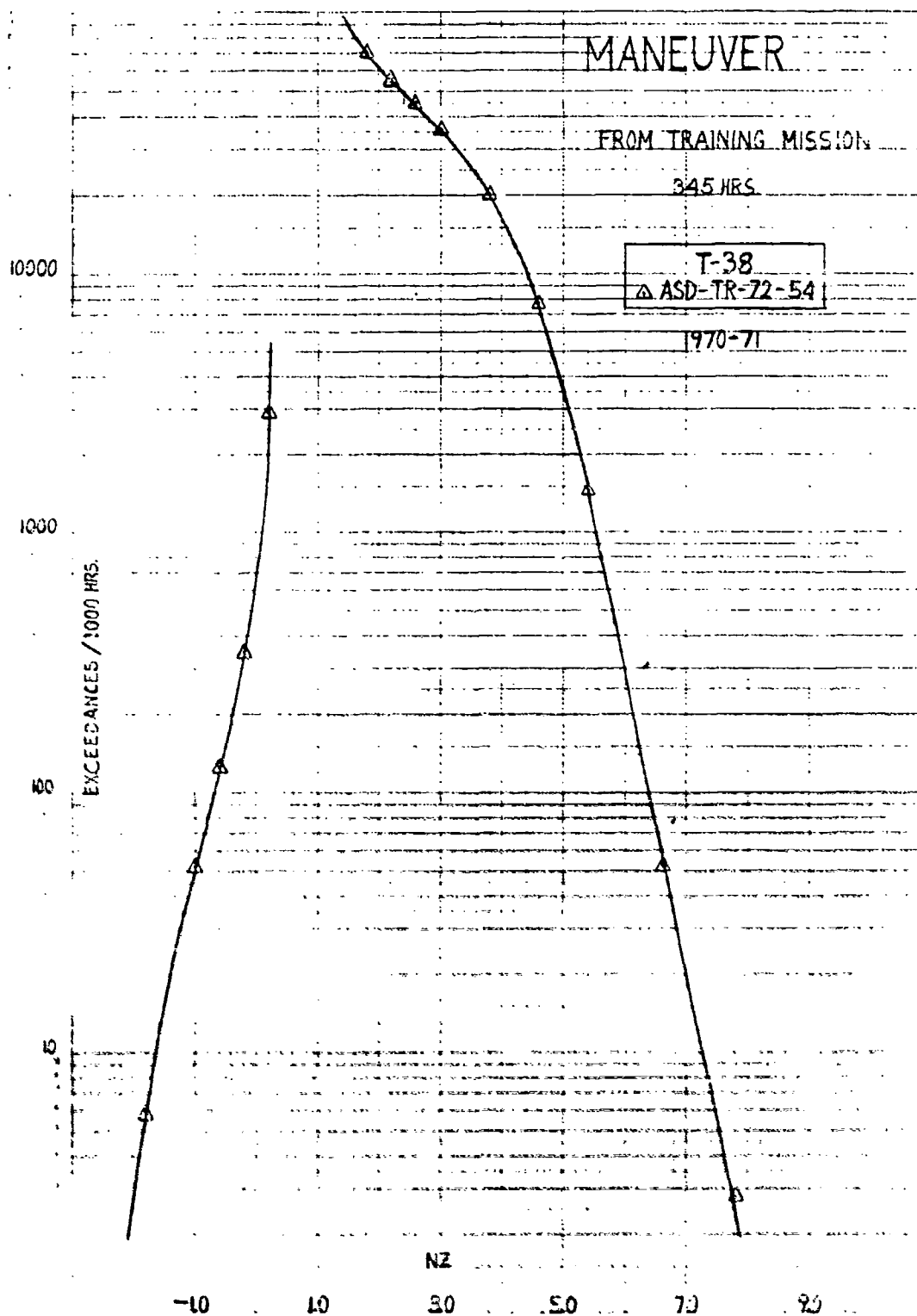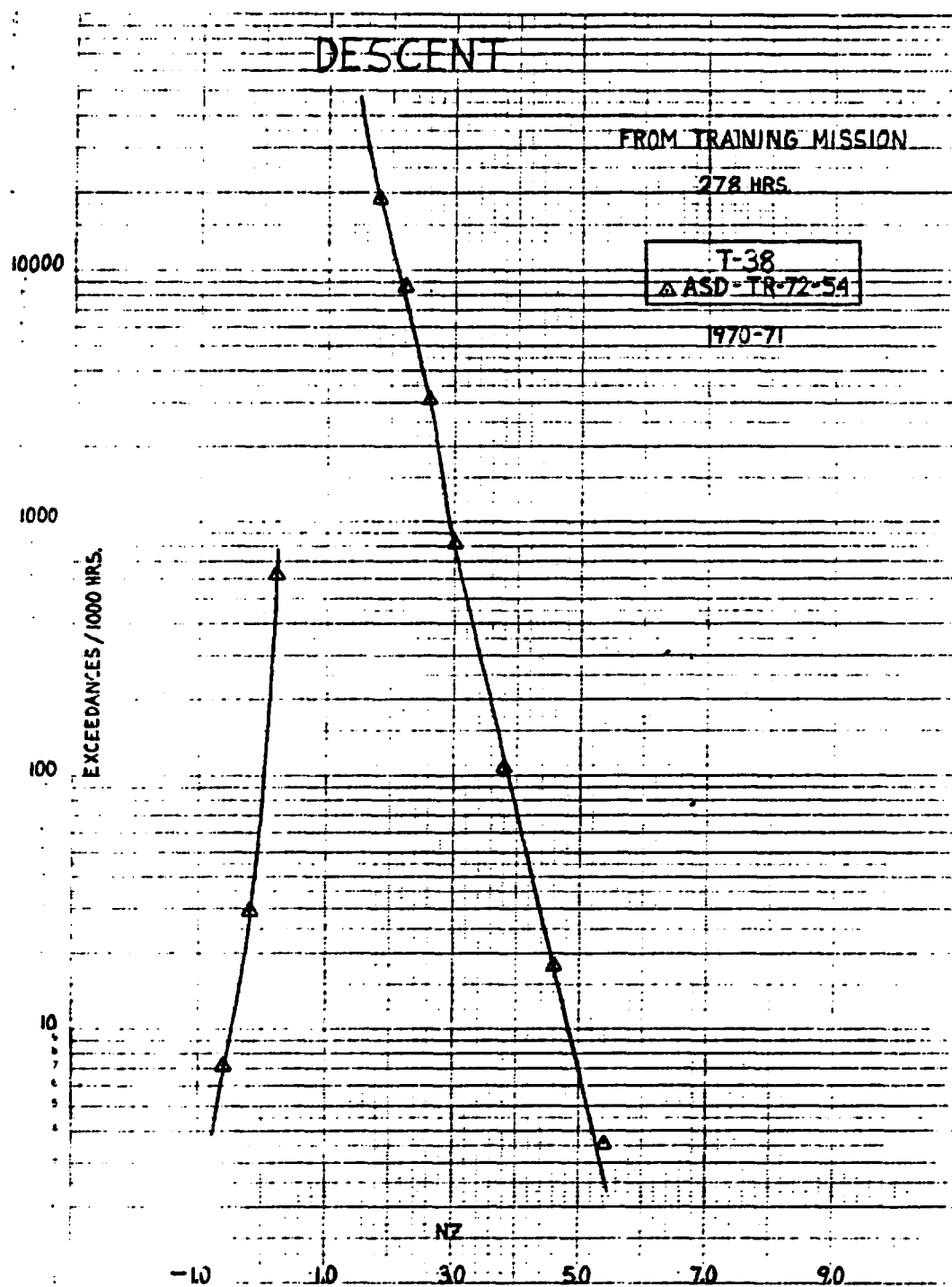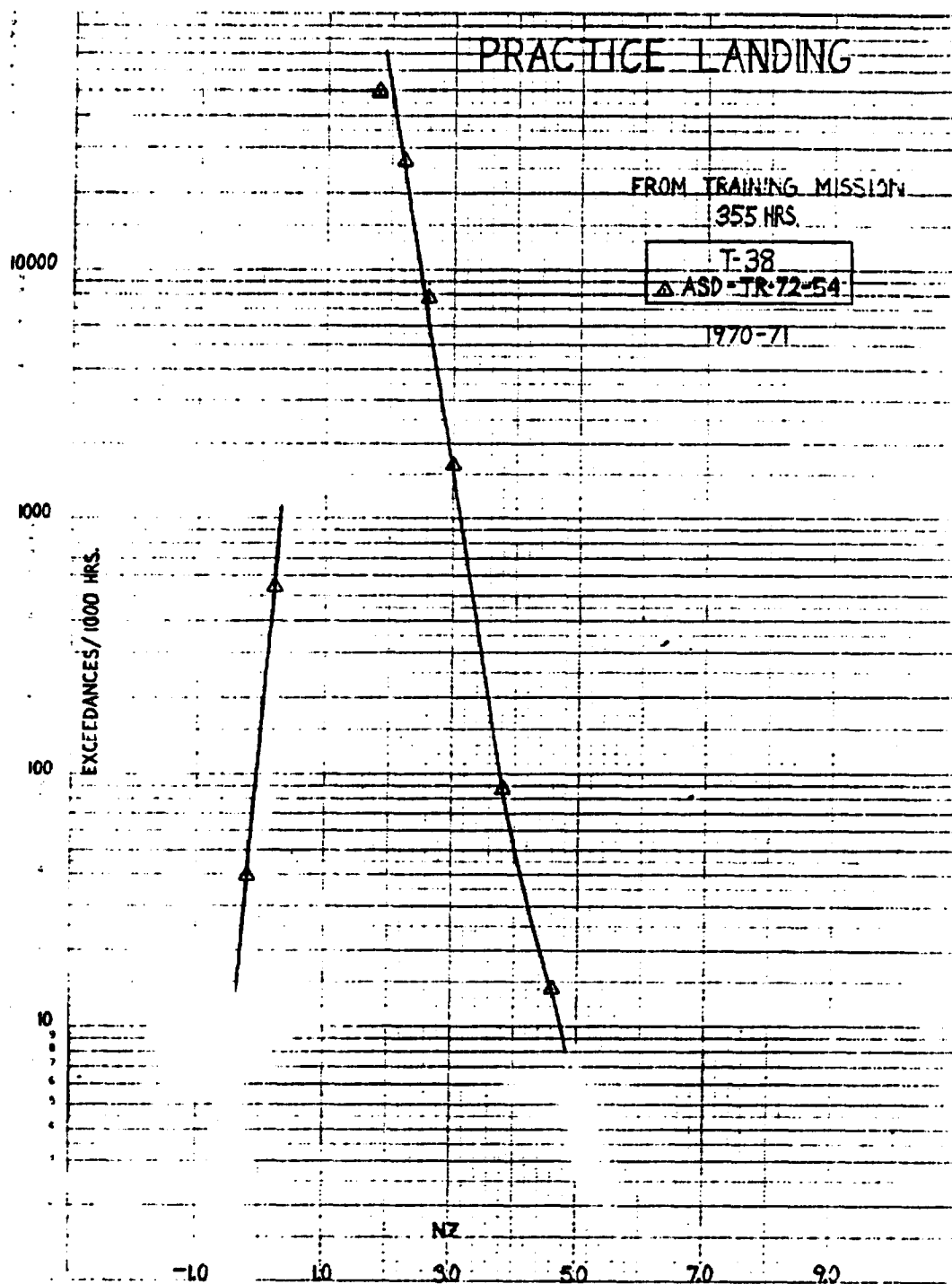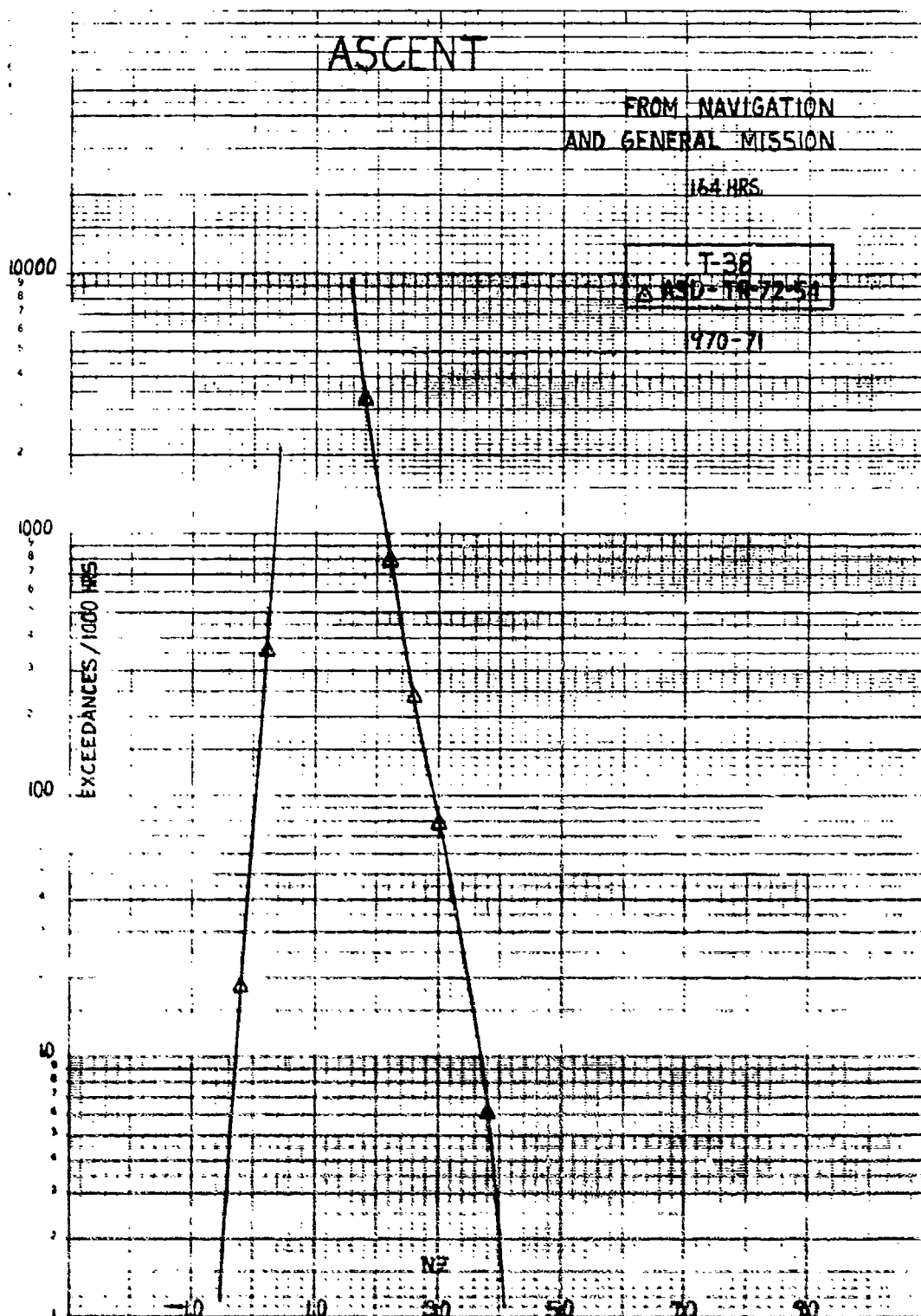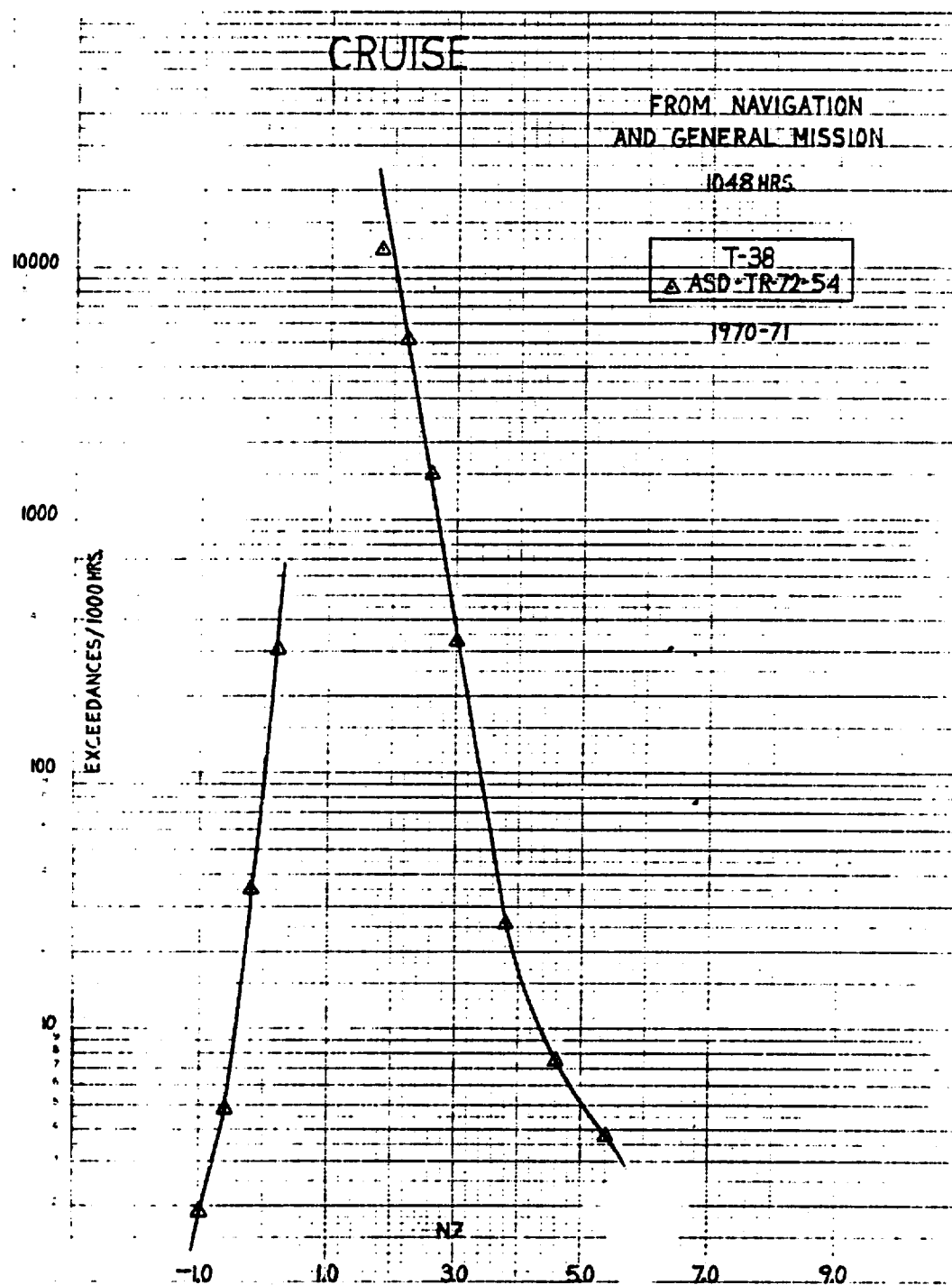
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